1.1 Documentation Presentation

This documentation is designed for users implementing a FIPIO fieldbus or a FIPWAY network. The complete documentation set is structured as follows :

This Reference Manual covering the FIPIO fieldbus and FIPWAY network :

- Operating principles,
- Network installation and testing principles,
- Operation, adjustment and diagnostic possibilities,
- Technical characteristics,
- Terminology including a glossary of terms.

Specialized User's Manuals are available for each device or family of devices that can be connected to a FIPIO fieldbus or a FIPWAY network. The main points covered by these manuals include :

- Device description,
- FIPIO fieldbus or FIPWAY network implementation or connection of each device,
- FIPIO fieldbus or FIPWAY network performance,
- Remote diagnostic functions via the network.

This document refers to the manuals required for the complete implementation of the application. A list of these manuals is provided in the Appendix, part E section 3.

1.2 AEG Schneider Automation's FIPIO and FIPWAY Product Line

AEG Schneider Automation has developed two types of network architectures for decentralizing peripherals, intelligent devices and services for long distance data exchange. These architectures are as follows :

- The FIPIO fieldbus for sensors, preactuators and terminals for use with the TSX series 7 and APRIL® series 1000 PLCs,
- The FIPWAY economic single cell network.

The FIPIO fieldbus and the FIPWAY network are fully compatible with the FIP standard.

1.2-1 About the FIP Standard

FIP is a set of UTE standards that has been tailored to "real time" communication requirements. This type of communication is needed for the implementation of reflex automation systems.

This standard is based on a three-layer communication system together with the network management function. It complies with the special requirements of fieldbuses and cell networks.

FIP is based on the principle of data broadcasting. Data exchange takes place as follows :

- A call is sent by the bus controller (called the bus arbiter) to all stations and is addressed to a producer subscriber and all consumers concerned,
- A response is broadcast by this producer subscriber to all stations and can be used by all consumer subscribers.

FIP accepts two types of application service :

- **A distributed database** (cyclic variables) which is exchanged periodically between the devices connected to the network and does not require application programs. This information is available to all consumers at the same time, thus providing data coherence and facilitating synchronization between devices,
- **A message handling system** which, on request, sends messages in point-to-point mode or in broadcast mode. This is very useful for configuration, adjustment, diagnostics and maintenance of intelligent sensors and preactuators as well as for operating and operator dialog functions.

These services are managed by a broadcast bus with a bus arbiter running on a 150-Ohm shielded, twisted pair.

1.2-2 The FIPIO Fieldbus

FIPIO is a fieldbus used with TSX series 7 and April® series 1000 PLCs. With this bus, the inputs / outputs of the PLC and its industrial peripheral can be decentralized and located on the factory floor near the operating equipment.

FIPIO uses cyclic variables to refresh remote I/O status. This operation is performed at the same rate as the PLC cycle.

The variables and the aperiodic message system are used for all configuration, adjust, diagnostics and operator dialog functions.

No special skills are needed to develop an application that uses FIPIO fieldbuses. The designer only has to declare the devices connected to each bus in his software workshop, like the procedure used for rack-mounted I/O modules. In the case of TBX I/O, he then assigns each group of TBX channels to the appropriate PLC task. The software workshop automatically generates the network operating parameters which are then downloaded into the PLC. A series of screens will help the operator with the configuration and adjustment of devices connected to the bus.

On series 7 equipment, during start-up or when maintenance is being carried out on the installation, FTX 417 and FTX 507 programming terminals can be connected to any point of the FIPIO bus. All the software workshop services are available immediately : adjust, diagnostics, programming etc. The terminals can be connected to and disconnected from the fieldbus without having any effect on operation. If the programming terminal is connected to dedicated address point 63, it can use the services of the software workshops for the PLC controlling the FIPIO bus as well as for any other remote PLC connected to the network. This is achieved through the transparency of the X-WAY communication architecture.

On a series 1000, the same services are integrated in the ORPHEE or ORPHEE-DIAG software workshop.
In addition, the SYSDIAG tool can be used with the APRIL 5000 PLC for diagnosing possible wiring problems on the FIPIO bus.

The operation of the installation is made easy by connecting one or more CCX 17 operator terminals, located as close to the operating equipment as possible, at any point on the fieldbus.

The wide range of TBX remote I/O modules available, means that the interfaces connected to the FIPIO fieldbus are tailored to meet the requirements of each type of installation.

1.2-3 FIPWAY Cell Network (series 7 only)

FIPWAY is the low-cost cell network that complies with the FIP standard and is built into X-WAY communication architectures.

FIPWAY provides simple and efficient coordination between all the TSX series 7 PLCs, from the TSX 17 micro-PLC through to advanced high performance processors such as the TSX 107 and PMX 107. When connected to FIPWAY, FTX programming terminals and CCX control and supervision systems make it easier to implement and use the network.

FIPWAY starts up automatically as soon as the devices have been switched on because of its pre-defined operating mode and the use of a floating bus arbiter. It does not have to be configured first.

FIPWAY supports all X-WAY services :

- Distributed database : common words (COM) exchanged cyclically among all the stations without the need for application programs and used at each point as local variables,
- UNI-TE industrial message handling system for equal level communication between devices. It is used for control, adjustment, diagnostics and program transfer functions,
- Application-to-application communication between all the devices connected to the network via standard text function blocks or high priority blocks such as telegrams,
- Multiple network transparency through the X-WAY addressing system which allows a terminal connected to a PLC at any point of an installation to access any device on the network as if it were physically connected to it.

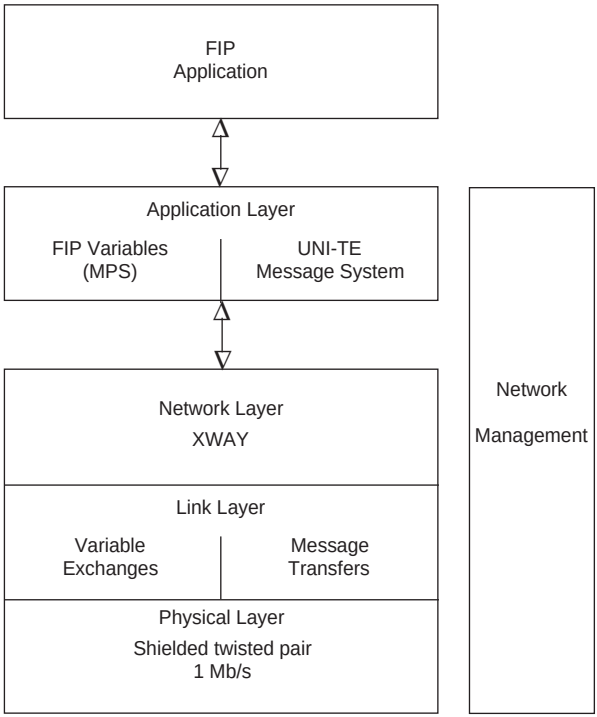
Since the programming interfaces remain unchanged, a TELWAY installation can run FIPWAY without modifying the application programs if an extension is mounted.

As FIPWAY is fully integrated into the X-WAY environment, initially separate cell networks can be connected later in a workshop by a larger network such as MAPWAY or ETHWAY without modifying the application programs.

FIPWAY also supports all the X-WAY diagnostics and network management tools :

- For simple installations, SYSDIAG software does a basic quick diagnostic of the network and connected devices,
- Larger installations implementing a considerable number of devices or several networks will be configured and documented using PL7-NET software. They will be monitored in the operating and maintenance phases by NETDIAG software.

1.2-4 FIPIO / FIPWAY in a FIP Architecture



2.1 General

In order to create a FIPIO or FIPWAY architecture which will allow the different devices to be connected, AEG Schneider Automation can provide the following :

- TSX FP CAxxx trunk cable, available in lengths of 100, 200 or 500 meters,
- TSX FP CRxxx trunk cable, available in lengths of 100, 200 or 500 meters,
- TBX FP CFxxx remote power cable, available in lengths of 100, 200 or 500 meters, for sealtight TBX modules,
- TSX FP CCxxx drop cable, available in lengths of 100, 200 or 500 meters for sealtight TBX modules,
- TSX FP CE 030 cord for connecting the terminals,
- TSX LES 65 or TSX LES 75 connector for connecting the TSX series 7, model 40 PLCs,
- TSX FP ACC2 connector for extension or drop connection of the TSX 17 micro-PLCs,
- TSX BLP 01 connector for connecting the TBX remote I/O interfaces (IP20),
- TBX BLP 10 connector for connecting the sealtight TBX remote I/O interfaces (IP65),
- TBX BAS 10 connector for supplying sealtight TBX output modules,
- TSX FP ACC4 tap,
- TBX FP ACC10 tap (IP65),
- TSX FP ACC7 line terminator.

TSX FP CA xxx and TSX FP CC xxx cables can only be used for applications inside buildings, in standard conditions.
TSX FP CR xxx and TSX FP CF xxx cables are used to set up installations out of doors or in locations where they may be subject to harsh environmental conditions (chemical, climatic or mechanical). For further details, see the table in part D, section 3.1, Installing the cables.

Devices can be connected to a segment as follows:

- By extension with each device being connected to the previous one by the trunk cable or by the remote power cable (IP65)
- By means of a drop line with each device being drop-connected to the trunk cable via a TSX FP ACC4 or TBX FP ACC10 tap using either the TSX FP CCxxx drop cable, the TSX FP CA/CRxxx trunk cable,
- Using a combination of the above which comprises devices connected by extension and by drop cable.

A FIPIO or FIPWAY network consists of one or more segments connected together by repeaters.

The maximum length of a bus segment is 1000 meters and the maximum number of stations per segment is 32 (plus any repeaters).

To connect more devices or for lengths greater than 1000 meters, TSX FP ACC6 electrical repeaters or TSX FP ACC8 optical repeaters must be used. The repeater is connected to each segment by extension or using a drop cable.

2.2 Number of discrete TBX (IP65) supported by the drop cable and TSX FP CFxxx 24VDC power cable

The number of discrete TBX (IP65) depends on the length of the line in meters, the gauge of the electrical conductors which make up the line cable and the precision of the power supply.

The **gauge** used for the power supply conductors in this cable is **AWG 18**.

The various parameters are summarized in the two tables below. They are only valid for the discrete TBX product references (IP65).

a) For a 24 V DC power supply at **5%**

Number of TBX	1	2	3	4	5	6	7	8	9	10
Length of the line in meters	318	157	103	76	60	49	44	38	31	27

b) For a 24 V DC power supply at **10%**

Number of TBX	1	2	3	4	5	6	7	8	9	10
Length of the line in meters	222	109	71	52	40	33	27	23	20	18

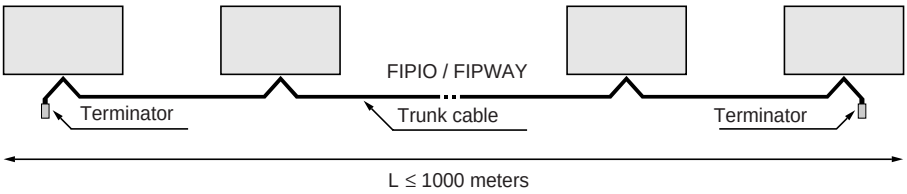
2.3 Types of Connection

2.3-1 Extension

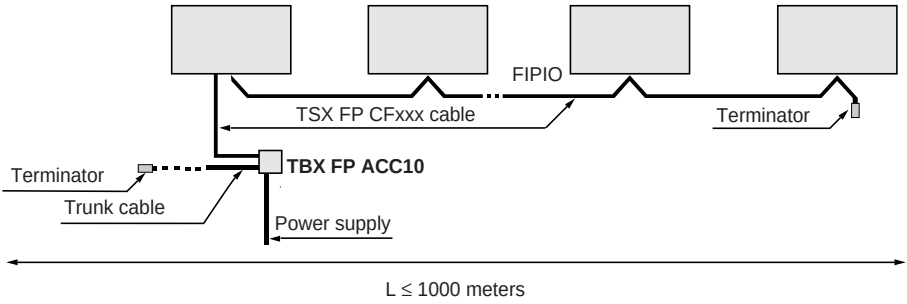
A FIPIO fieldbus or a FIPWAY network can be installed by direct station-to-station extension using TSX FP CA/CFxxx cables for TBX (IP20) and TSX FP CRxxx cables for TBX (IP65). The maximum length of a segment will then be 1000 meters.

Both ends of each segment must be fitted with a TSX FP ACC7 line terminator.

Example of an extension connection (IP20)



Example of an extension connection (IP65), on FIPIO only



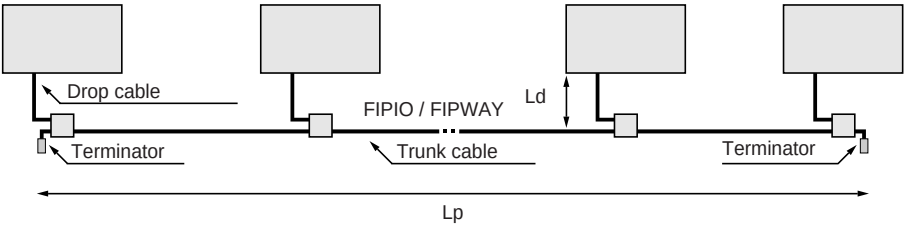
The TBX FP ACC10 tap must be used.

2.3-2 Drop Connection (TSX FP CCxxx drop cable)

A FIPIO fieldbus or a FIPWAY network can be installed by using TSX FP CA/CRxxx trunk cables and TSX FP ACC4 taps. The stations are connected using drop TSX FP CCxx drop cables.

Each segment must be fitted at both ends with a TSX FP ACC7 line terminator. The maximum length of the segment is given by the following relation :
Lp + 3∑Ld ≤ 1000 m.

Example of a drop connection using the TSX FP CCxxx drop cable



In order to use sealtight TBXs (IP65) on FIPIO only, a power supply must be connected to the TBX BLP 10 connectors.
The tap can be a TSX FP ACC4 or a TBX FP ACC10.

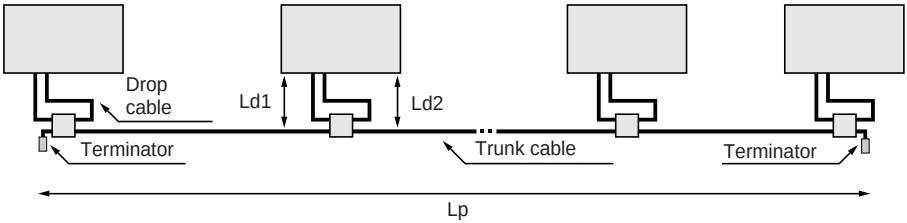
This type of drop connection can only be used for installations located inside buildings and operating under normal environmental conditions.

2.3-3 Drop Connection (TSX FP CA/CRxxx drop cable)

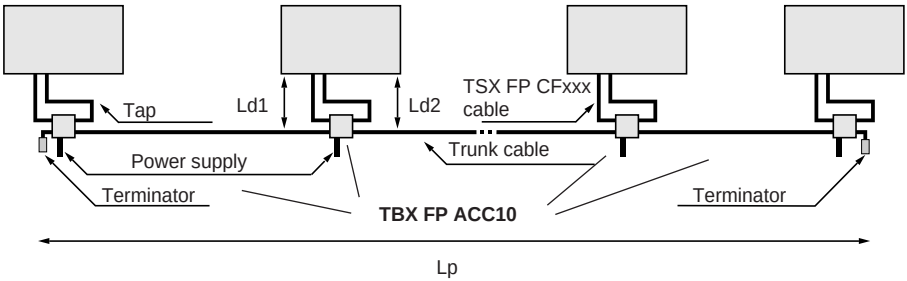
An alternative to the previous connection method is to install the TSX FP CA/CRxxx trunk cable and TSX FP ACC4 taps. The stations can also be connected using the TSX FP CA/CRxxx trunk cable (two lengths of drop cable).

Both ends of each segment must be fitted with a TSX FP ACC7 terminator. The maximum length of the segment is given by the following relation :
Lp + ∑Ldi ≤ 1000 m.

Example of a drop connection using the TSX FP CA/CRxxx cable



Sealtight TBXs (IP65) are drop connected (on FIPIO only) using the TSX FP CA/CRxxx trunk cable and the TBX FP CB100 remote power cable from TBX FP ACC10 taps.



TBX FP ACC10 taps must be used.

This type of drop connection is the only possible option for installations located out of doors or those subject to particular environmental constraints.
On this type of installation, the following cables must be used :

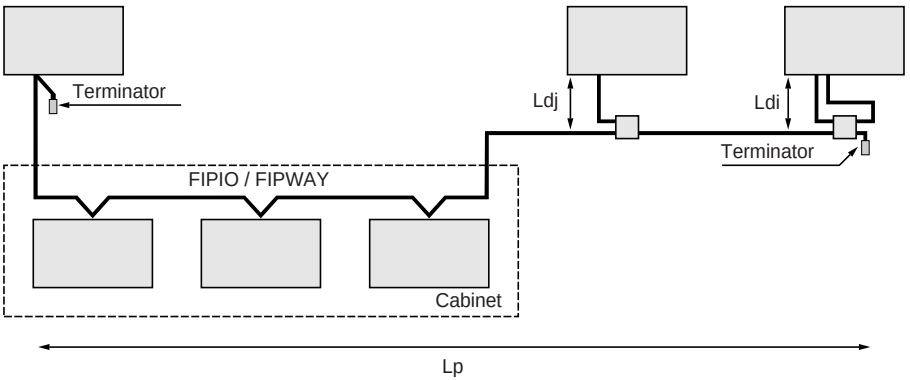
- trunk cable : TSX FP CR xxx
- tap cable :
  - sealtight TBX : TSX FP CF xxx
  - others : TSX FP CR xxx

2.3-4 Combined Connection (extension and drop)

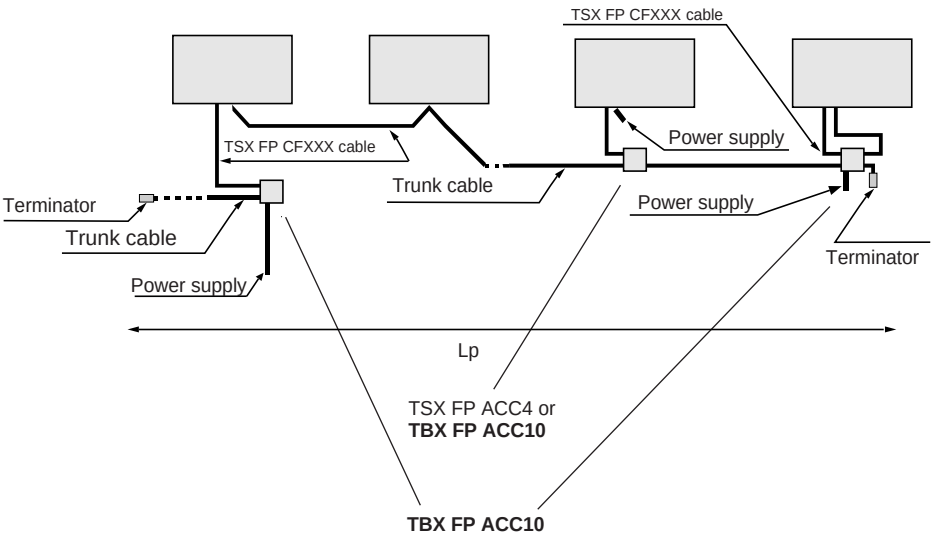
The three connection modes that have already been described can be combined on the same installation. A combination of these types of connection can be used, for example, to connect the devices in an electrical control cabinet to the network with one type of cable etc.

Both ends of each segment must be fitted with a TSX FP ACC7 terminator. The maximum length of the segment is given by the following relation :
Lp + ∑Ldi + 3∑Ldj ≤ 1000 m.

Example of a combined connection (IP20)



Example (on FIPIO only) of a combined connection for sealtight TBXs (IP65)

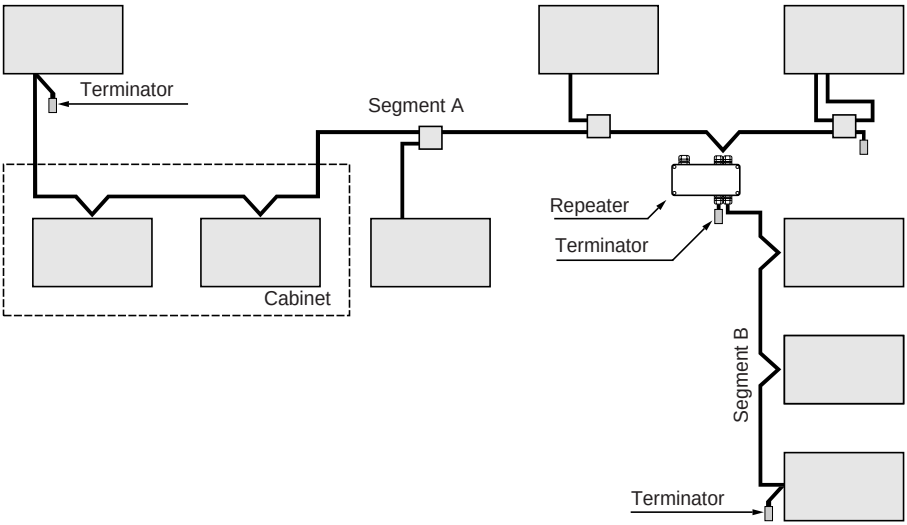


2.3-5 Network Architecture using a Repeater

The use of a repeater makes it possible to increase the range of the network and/or to increase the number of stations connected. Connection can also be made by extension, drop cable or a by combining the possibilities.

Both ends of each segment must be fitted with a TSX FP ACC7 terminator. The maximum length of each segment is 1000 meters (including drop cables). The length of the trunk depends on the type of drop cable used (see sections 2.2-2 and 2.2-3).

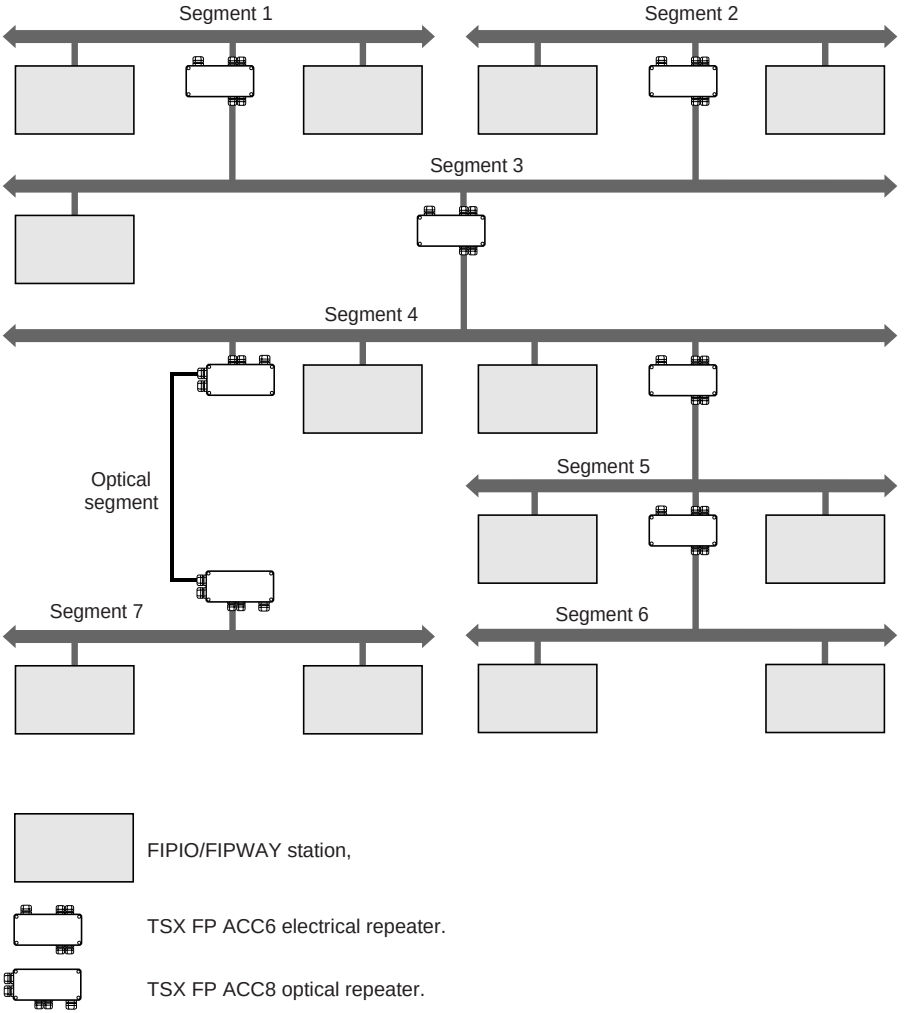
Example of architecture



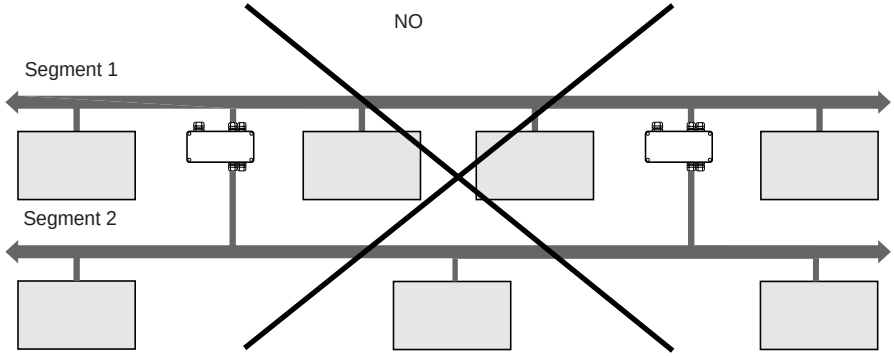
Further information relating to architectures using several repeaters can be found in Appendix 4.1, part E.

2.3-6 Architecture with Several Repeaters

It is also possible to cascade a maximum of four repeaters per segment in linear or tree type architectures to increase the range of the network and/or to increase the number of stations connected from 32 to a maximum of 64 (for all segments).



In an architecture that uses several repeaters (electrical and optical), only one path must connect two stations.



FIPIO/FIPWAY station,

TSX FP ACC6 electrical repeater

B

1.1 General

Note :
In this document, the term segment means the part of the network between two repeaters or bridges, the term network means all the segments with the same network address and the term multiple network means an architecture comprising several interconnected networks.

The FIPIO fieldbus is used mainly for level 0 applications (controlling sensors and actuators). With this bus, all or part of the automation control system can be located near the production site (I/O modules, variable speed drives, identification systems, PC-compatible workshop terminals and operation and control system).

These applications are carried out by the set of devices that can be connected to the FIPIO fieldbus :

- TSX 7 modular PLCs and PMX 7 model 40 PLCs,
- APRIL® Series 1000 PLCs,
- TBX remote I/O modules (discrete and analog),
- FTX 507 programming terminal,
- FTX 417 programming terminal,
- CCX 77 supervision and control systems,
- PC terminal,
- TSX 17 micro-PLC,
- CCX 17 control panel,
- ALTIVAR variable speed drives,
- SEPAM 2000 distribution and monitoring system,
- concentrators for Endress + Hauser measurement sensors.

FIPIO supports all the communication services required by automation personnel with guaranteed I/O refresh time, network transparency and the UNI-TE message handling system services :

- The dedicated exchanges on the FIPIO bus are exchanges of input channel acquisition status variables and output channel commands. These exchanges are performed cyclically without any intervention from the application program.
- Other data can also be exchanged on the FIPIO fieldbus such as remote device configuration variables and UNI-TE messages (these services allow the bus arbiter to send parameters to other devices).

The FIPIO fieldbus can be used in several ways :

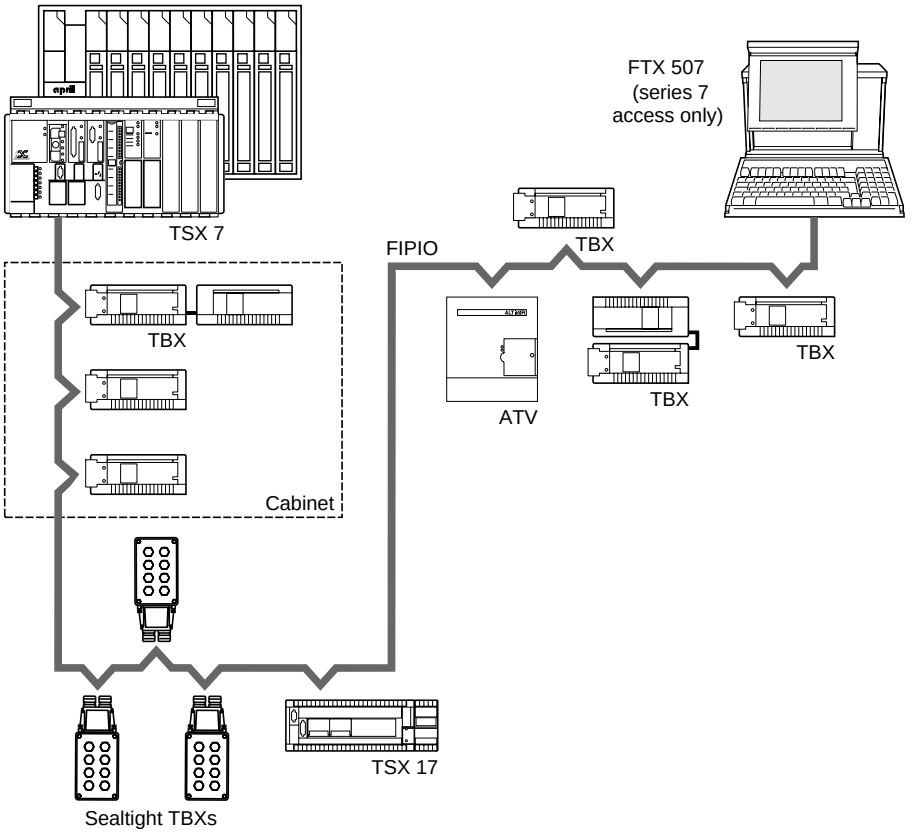
- In a simple environment (single station), with Series 7 and Series 1000 PLCs,
- In a more complex environment (multiple station) where several FIPIO segments can be connected in the workshop by a higher level local network such as ETHWAY (for Series 7 only).

The various architecture possibilities are shown on the following pages.

1.2 Examples

1.2-1 Single Station Architecture

Automation of a Production Line

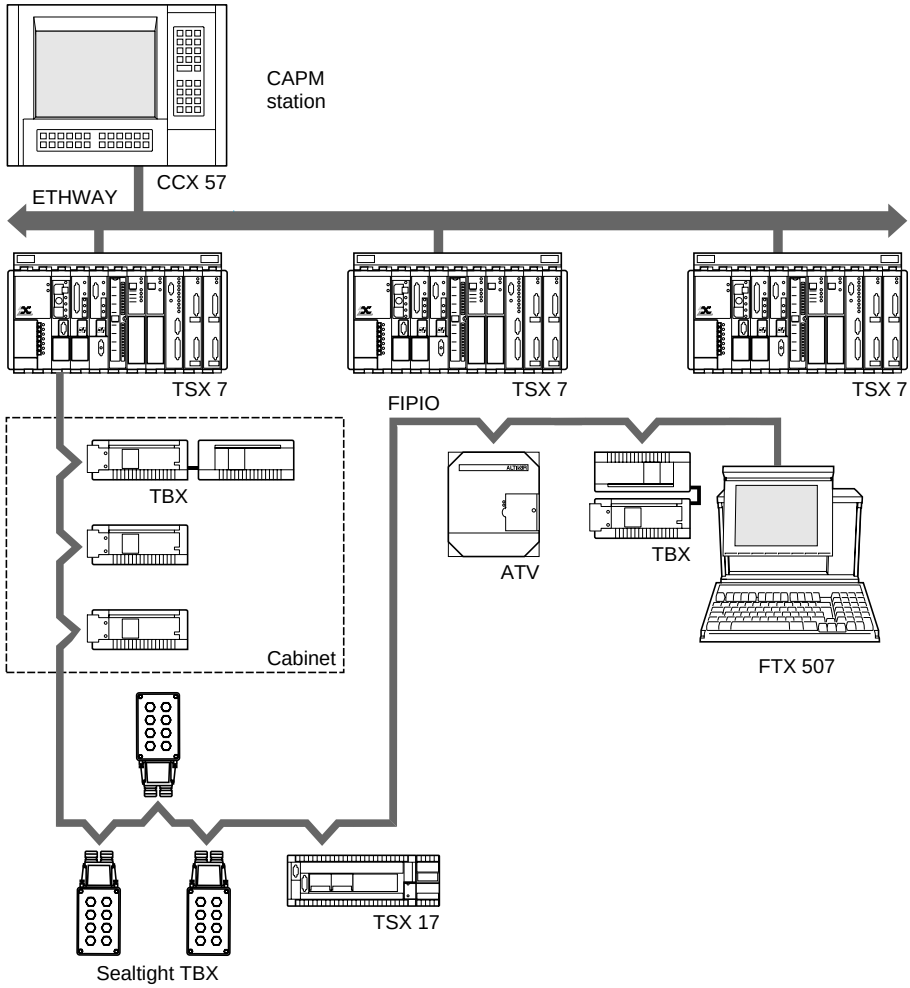


Delocalizing I/O means that the constituent parts of the automation system no longer have to be installed in the PLC control cabinet and can be located near the operating equipment on the factory floor

Decentralization of industrial operations favors the manufacture of modular machines or ones which can be easily dismantled. This means that the best use can be made of the preprocessing and diagnostics functions offered by intelligent sensors and preactuators. Control and diagnostics systems (for Series 7 PLC only) can therefore be set up in the heart of the installation where they are really useful.

1.2-2 Multiple Station Architecture (Series 7 only)

Production Factory



In this type of hierarchical architecture, the FIPIO fieldbus is connected by the plant-wide ETHWAY network.

The transparency provided by this type of architecture carries production and distribution data to the Computed-assisted Manufacturing System (CAM).

If the programming terminal is connected to dedicated address 63 on the FIPIO bus, it can access the complete architecture without having to be configured (if connected to a different address, it can access all the devices connected to FIPIO).

2.1 General

A device on the FIPIO fieldbus is identified by its connection point.

The connection point number is the physical address of the device on the bus and takes a value from 0 to 63.

> Address 0 is reserved exclusively for the bus controller PLC.
>
> Address 63 is allocated to the programming terminal. This dedicated address allows this terminal to access the complete network architecture without having to be configured first.
>
> All the other addresses can be used by devices that can be connected to FIPIO, but they must first be configured with programming software (for more information, see section 5 or 6, Part D).

Bus arbiter

On a FIPIO bus at a given moment, a unique station authorizes data exchange : this is the active bus arbiter which controls access to the medium.

The function of the bus arbiter is simple. It scrolls the list of messages to be sent and then decides when the aperiodic exchanges of variables and messages requested will take place.

The list of cyclic exchanges and the windows assigned for aperiodic traffic form a macro-cycle. The continuous scanning of this macro-cycle is performed by the active bus arbiter.

On a FIPIO bus, the macro-cycle is linked to the data exchange requirements of the application program. This cycle will :

- Scan the status variables and the device command variables, taking into account the need to update the PLC tasks,
- Assign a window for aperiodic exchange of variables for configuration, control and diagnostics of remote devices (this window allows exchanges of five 128-byte variables per second),
- Assign a window for aperiodic exchanges of messages which will be shared among all the devices using the message system service (this window allows exchanges of twenty 128-byte messages per second; this data-rate is 50 messages per second for 32-byte messages).

2.2 Characteristics

Structure

Nature	: FIP-standard open industrial fieldbus.
Topology	: Devices connected in extension or drop mode.
Access method	: Controlled by the bus arbiter.
Communication	: Communication is by the exchange of variables which the user can access in the form of : - PL7-3 object and X-WAY datagram for series 7, - ORPHEE language words for series 1000.
Dedicated exchanges	: Cyclic exchanges of status variables and remote I/O exchanges commands (parameter variables and X-WAY datagrams are also exchanged).

Transmission

Mode	: Base band physical layer on shielded twisted pair (French standard NF C46 604).
Binary data-rate	: 1 Mb/s.
Medium	: Shielded twisted pair (impedance 150 Ohms).

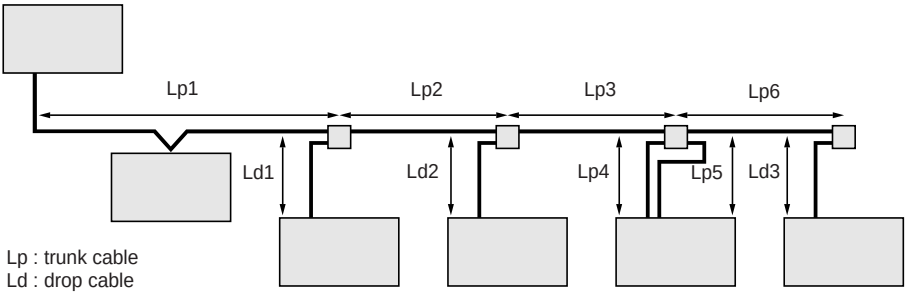
Configuration

Nbr of connection points	: 64 logical connection points for the whole architecture.
Nbr of segments	: A maximum of 5 (cascaded) using electrical or optical repeaters (maximum of 4 cascaded).
PLC	: One PLC at address 0.
Terminal	: One FTX 507, CCX 57/77, FTX 417 or PC-compatible terminal connected to connection point 63. (Several PCs can be connected to the FIPIO bus but only the PC connected to connection point 63 will have access to all the console functions without having to be configured first. Once the other PCs have been configured in the software workshop, they can access all the devices connected to the FIPIO network up to the level of the bus controller PLC).
Length	: The length of a segment depends on the type of drops used. Maximum length is 1000 meters without a repeater for a segment and 5000 meters between end devices (5 segments).
Multi stations (series 7 only)	: Network transparency is ensured with MAPWAY or ETHWAY.

Configuration (cont'd)

Drops : These connections are made through the use of taps, drop cables or loop-back of the trunk cable. If a drop cable is used, the length of the drop is equal to three equivalent trunk cable lengths. The length of a segment is therefore equal to :

L = sum of the Lpx + 3 x sum of the Ldx ≤ 1000 m



Services

Remote I/O : Exchanges of I/O channel status variables and output channel commands in cyclic mode without any intervention from the application program.
Remote device management (configuration etc.) in aperiodic mode without any intervention from the application program.

UNI-TE : Point-to-point request service with confirm, maximum of 128 bytes. This service can be used by all the stations connected to FIPIO that support this service.

Data integrity : Control characters on each frame and message acknowledgment (French standard NF C46 603).

Supervision : The PLCs and their inputs / outputs (local or remote) are diagnosed by one of the following terminals : FTX 507, CCX 7 FTX 417 or PC-compatible, with SYSDIAG software for series 7.
ORPHEE, ORPHEE-DIAG software, as well as the ANALYZER function in the SYSDIAG (DOS) tool for series 1000.

Maximum size of the data sent

Variables : 128 bytes.

Messages : 128 bytes.

Message data-rate : twenty 128-byte messages per second.

Task Network Cycle Time

Network cycle time corresponds to the time between two scans of the same module on the bus. There are two cases. The application is either a single task application or a multiple task operation (on series 7 only). The calculation for series 1000 is the same as for the series 7 single task.

- **Single task application (series 7 and series 1000)**

  For a single task application (guideline), the value of the network cycle time (Nct) in milliseconds is obtained using the following formula :

Tcr = 1 + 0.5 x Number of TBX connection points in the application (*)

- **Multiple task application (series 7 only)**

  For a multiple task application TBXs are configured in each of the tasks. The value of the network cycle time of each of the tasks in milliseconds is obtained as follows :

Tcr_fast	=	1 +0.5 x Equivalent number of TBX connection points (*)
Tcr_mast	=	Tcr_fast / K
Tcr_aux	=	Tcr_fast / K'

  where :

  K = Fast task cycle time / mast task cycle time,

  K' = Fast task cycle time / auxiliary task cycle time,

Equivalent nbr of TBX = Nbr of TBX configured in the fast task + (K x Nbr of TBX configured in the mast task) + (K' x Nbr of TBX configured in the auxiliary task)

(*) for 1 and 5 TBX, the formula is : Nct = 1.5 + 0.5 number of TBX connection points

Example :

Cycle Time	number of TBX	K, K'
fast	10 ms	2
mast	40 ms	81/4
aux	120 ms	41/12

The **equivalent number of connection points** is :

2 + (1/4 x 8) + (1/12 x 4) = 4.33 rounded off to **5**

Tcr_fast = 1 + (0.5 x 5) = **3.5 ms**

Tcr_mast = 3.5 : 1/4 = **14 ms**

Tcr_aux = 3.5 : 1/12 = **42 ms**

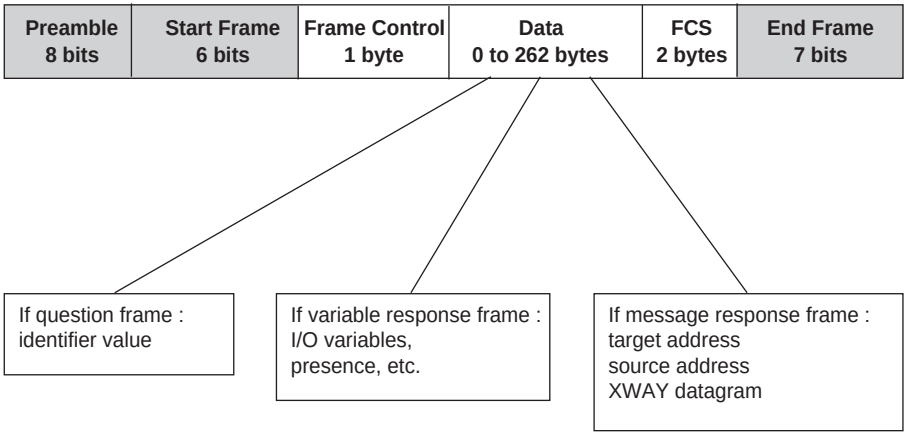
2.3 FIPIO Exchange Format

The following information is not absolutely necessary when using a FIPIO bus. It is provided for familiar users as a brief explanation of how the network operates.

A data exchange on the FIPIO bus comprises two frame transfers :

- A question frame containing the identifier of the variable to send or the source entity of a message to send,
- A response frame containing the value of the identified variable or the application message sent on the bus.

The FIPIO frame is broken down as follows :



Preamble :

This 8-bit string allows the receivers to synchronize to the clock of the source station.

Start frame delimiter :

This start frame delimiter comprises six bits and allows the date link layer to locate the start of its assigned data.

Frame control :

This byte tells you what type of frame has been exchanged :

- Question frame : identified variable, message or request,
- Response frame : identified variable, message acknowledged or not acknowledged, acknowledgment or request etc.

Data :

This field contains :

- The identifier value (two bytes) for a question frame,
- The value of the application variable (2 to 128 bytes) for an identified variable response frame,
- A source address (three bytes), a target address (three bytes) and an X-WAY datagram (128 bytes) for a message response frame,
- A string of identifiers for a request response frame (system service).

FCS (frame check sequence) :

These two bytes are used to check that the data exchange is performed correctly. The control code is calculated by the source station and then sent after the data. The receiving station recalculates the code and compares it with that received from the source. If the two do not match, the message is refused by the target station.

End frame delimiter :

The end frame delimiter comprises seven bits and allows the data link layer to locate the end of its assigned data.

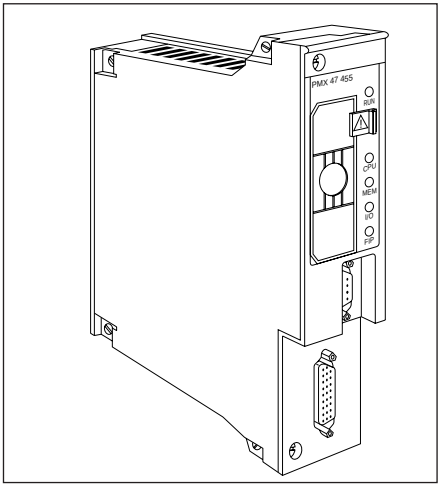
3.1 Processors

3.1-1 TSX and PMX Processors

The TSX P47-415, TSX/PMX P47-455, P67-455, P87-455 and P107-455 PLC processors are all equipped with a FIP link.

The default operating mode of this link is FIPWAY, meaning that the PLC must be configured with XTEL-CONF in order for it to be able to run in FIPIO mode.

For more information on this configuration, refer to section 5, part D.



The PLC processor is connected to the FIPIO bus via the TSX LES 65 or TSX LES 75 terminal blocks.

When operating in FIPIO mode, these PLC processors support the following services :

- Bus arbiter election system,
- UNI-TE client and server (maximum of 128 bytes exchanged) for stations with addresses 0 to 63,
- Application-to-application communication using text function blocks (maximum of 128 bytes exchanged) for stations with addresses 0 to 63.

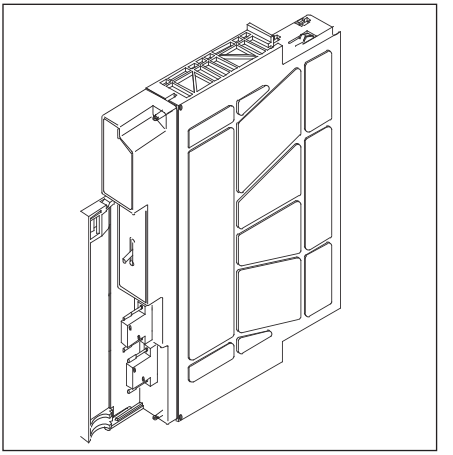
For more information on the description and functions of the FIP link built into the processors refer to the Model 40 Processor Manual.

3.1-2 APRIL 5000 Processors

The CPU5030 and CPU5130 PLC processors are all equipped with a FIPIO link as standard.

The PLC processor is connected to the FIPIO bus using the KIT5130 cord.

For more information on the description and functions of the FIPIO link built into the processors refer to the APRIL 5000 PLC Manual Ref. TEM30000E.



3.2 TBX Remote I/O

AEG Schneider Automation offers two types of TBX remote I/O interfaces :

- TBX monobloc low-cost modules made of one element. They comprise 16 inputs or 16 outputs.
- TBX discrete and dialog modular interface modules composed by the user by associating one communication module and a connection base. This assembly can be extended by adding a second connection base or extension module.

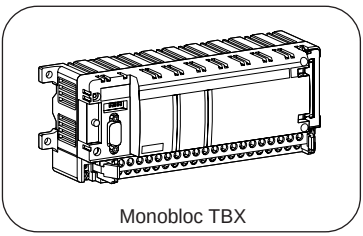
  They are connected to the FIPIO fieldbus by a TBX BLP 01 SUB-D 9-point connector, by means of an extension or drop cable.
- TBX sealtight (IP65) made of one element. They comprise 8 inputs or outputs.

  They are connected to the FIPIO fieldbus by a TBX BLP 10 SUB-D 15-point connector, by means of an extension or drop cable.

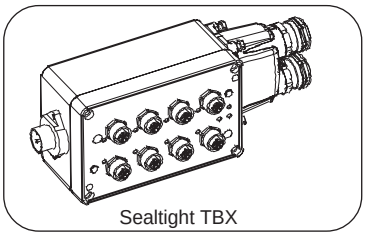
These remote I/O will :

- Reduce the cabling needed for the sensors and actuators,
- Do away with the mechanical stress inherent in cableways,
- Reduce connection design and test time,
- Provide more machine or installation availability,
- Provide open-ended installations that can be tailored to requirements through the number and type of modules used,
- Allow a more rational operation of the PLCs,

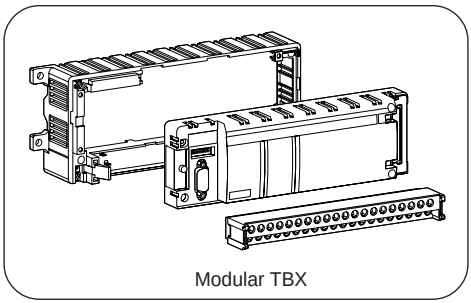
For more information on these modules (characteristics, implementation etc.) refer to the TBX Remote I/O Module Manual.



Monobloc TBX



Sealtight TBX



Modular TBX

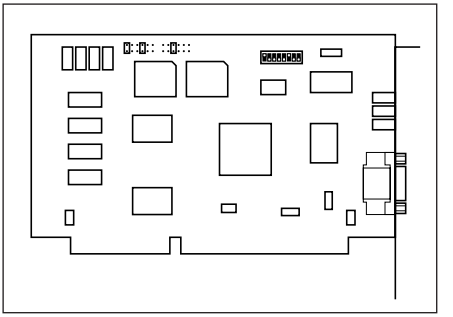
3.3 TSX FPC 10 Module

This module is used to connect the following to the FIPIO bus :

- FTX 507 programming terminals,
- CCX 57/77 supervision systems,
- Any machine equipped with a PC AT bus running on DOS 3.1 or higher or OS/2 ≥1.1 or higher.

The TSX FP CE 030 cable and the TSX FP ACC4 or TBX FP ACC10 tap are used to connect the above devices to the FIPIO bus.

This module is a half-size PC extension board. It slides into one of the slots on the bus.



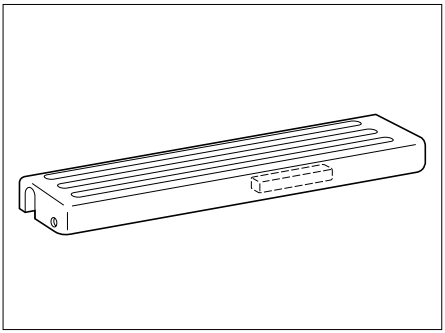
A FIP OS/2 driver, a FIP DOS driver and an Installation Manual are provided with this module.

The programming terminal that includes the TSX FPC 10 interface module must be connected to address 63 of the FIPIO bus to be able to access the complete architecture without having to be configured first.

For more information on this module refer to the TSX FPC 10/20 User's Manual.

3.4 TSX FPC 20 Module

This module is used to connect the FTX 417-20 programming terminal running on DOS 3.3 or higher or on OS/2 1.1 or higher to the FIPIO bus.



The TSX FP CE 030 cable and the TSX FP ACC4 or TBX FP ACC10 tap are used to connect the above devices to the FIPIO bus.

This module slides into the slot provided in the FTX 417-20 terminal.

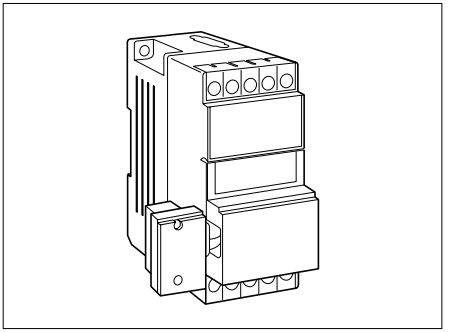
A FIP OS/2 driver, a FIP DOS driver and an Installation Manual are provided with this module.

The programming terminal that includes the TSX FPC 10 interface module must be connected to address 63 of the FIPIO bus to be able to access the complete architecture without having to be configured first.

For more information on this interface module refer to the TSX FPC 10/20 User's Manual.

3.5 TSX FPG 10 Module (series 7 only)

This module in version V1.1 is used to connect TSX 17-20 micro PLCs equipped with the PL7-2 V5 language micro-software cartridge. A TSX FP ACC2 SUB-D 9-point male connector is used to connect this module to the FIPIO bus by means of an extension or drop cable.



This module is in the same standard format (52 mm) as the TSX 17 extension modules and connects to the base PLC or to the previous extension block by a cable built into the module.

The TSX 17-20 micro-PLCs only support one connection to be made to the FIPIO bus. On the bus, they can only act as agent.

The micro-PLCs support the following services :

- UNI-TE server (maximum of 32 bytes exchanged) for stations with addresses 0 to 62,
- Application-to-application communications using text function blocks (maximum of 32 bytes exchanged) for stations with addresses 0 to 62.

Note :

The simultaneous use of the services offered by a TSX 17-20 module (UNI-TE and application-to-application communication services) implies that the module has a station address no higher than 15.

The station address 0 must be a model 40 TSX/PMX PLC with a version 5.2 or higher processor.

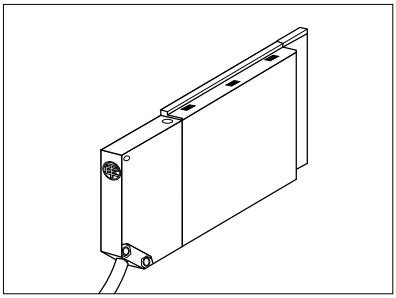
For more information on the use of this module, refer to the TSX FPG 10 Module User's Manual.

3.6 PCMCIA type III Cards

The PCMCIA type III cards are used as standard for connecting various devices to the FIPIO bus :

- FIPIO TSX FPP 10 (*) agent PCMCIA card,
- FIPWAY TSX FPP 20 (*) PCMCIA card.

Depending on the devices, cables or DOS and OS/2 drivers on diskette are used with these cards. They are all connected to the TSX FP ACC4 or TBX FP ACC10 taps.



3.6-1 Module for FTX 417-40 Notebook or PC-compatible

The TSX FPP K 200M module for PCMCIA type III slot consists of :

- 1 FIPWAY TSX FPP 20 PCMCIA card,
- 1 set of DOS and OS/2 driver 3"1/2 diskettes.

A TSX FP CG010/030 connection cable (1 or 3 m) is required to connect it to the TSX FP ACC4 or TBX FP ACC10 tap.

3.6-2 Module for CCX 17 Operator Panel

The TSX FPP 10 card with a TSX FP CG010/030 cable connect the CCX 17 panel to the TSX FP ACC4/TBX FP ACC10 tap.

3.6-3 Module for ATV 16 Variable Speed Drive

The TSX FPV 16 V5M module is used to connect asynchronous motor variable speed drives via ATV 16 fitted with a VW3-A16 303 communication module. The TSX FPV 16V5M module consists of :

- 1 FIPIO TSX FPP 10 agent PCMCIA card,
- 1 TSX FP CG010 connection cable,
- 1 TSX FP ACC4 tap.

(*) respectively TSX FPP 01 and TSX FPP 02 until the first quarter of 1995.

3.7 Open Access of the FIPIO via a PCMCIA Card

AEG Schneider Automation offers a complete development system for rapid and economical FIP connections for a wide range of products and ensures their correct operation in a FIPIO environment. This development system comprises :

- A hardware base : a standard format PCMCIA card
- The FIP software built into this card,
- A system for integrating new FIP-compatible equipment into the X-TEL and MINI X-TEL software workshops (V5 and higher),
- Technical assistance with product development and validation.

3.8 Open Access of the FIPIO via the Built-in FIP Component

AEG Schneider Automation offers FIP components for developing connection interface modules for other manufacturers' products. This development requires expertise in the integration of components and information systems. For this type of development, consult our Regional Technical Center.

This type of development was created for :

- A SEPAM 200 (Merlin Gérin) distribution station control and monitoring system
- Concentrators for Endress + Hauser measurement sensors.

  Endress + Hauser equipment can be connected to the FIPIO fieldbus via Commutec transmitters and the ZA 674 communication interface (supplied by Endress + Hauser). Integration into the X-TEL or MINI X-TEL software workshop is provided by the TXT LF FP ZA 674 V52 software.

4.1 Remote I/O service

The FIPIO fieldbus supports the remote I/O service. This is the FIPIO dedicated service.

This service is used to exchange input status variables and output commands. Such exchanges are performed cyclically and automatically without any intervention from the application program.

Remote devices can be managed via this service (configuration etc.). These exchanges are aperiodic without any intervention from the application program.

In order to use this service, the remote I/O must be configured with the correct software workshop :

The XTEL-CONF station tool for series 7 (for more information on these configurations, refer to the X-TEL Software Workshop Manual).

ORPHEE environment for series 1000 (for more information on these configurations, refer to the ORPHEE Language and Software Manual).

The use of this service and the associated language interface are described :

For series 7 in the PL7-3 Languages, V5 Operating Modes Manual.

For series 1000 in the APRIL 5000 PLC Manual, Ref.TEM30000E.

The diagnostics and maintenance functions associated with this service are described : For series 7 in the SYSDIAG, PL7-2/PL7-3 Application Adjustment Software Manual.

For series 1000 in the ORPHEE Language and Software Manual, Ref. TEM10000E, and in the ORPHEE-DIAG Software Manual, Ref. TEM10800E. The SYSDIAG (DOS) tool is used for diagnostic and maintenance purposes.

4.2 UNI-TE Service

The FIPIO bus supports AEG Schneider Automation's UNI-TE industrial message handling system protocol. UNI-TE enables point-to-point communication using a question and answer dialog called Request/Confirm.

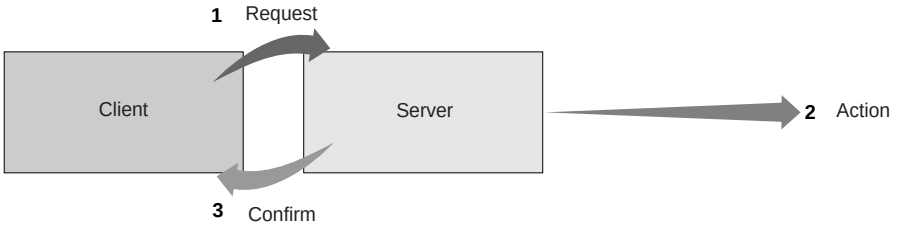
Dialog sequencing

A device that supports the UNI-TE protocol can be a :

CLIENT : This device initiates communication. It asks a question (reads), sends a command (writes) or an order (Run, Stop etc.).

SERVER : This device executes the order sent by the client and sends a confirm after execution.

The services supported depend on the type of device, e.g. PLC, programming terminal, supervision system. Depending on its function, each device can be a Client and/or a Server. A programming terminal is generally a Client on FIPIO and communicates with the server of the bus arbiter PLC.



UNI-TE is especially suited to applications such as supervision, diagnostics and control.

The maximum length of the messages is 128 characters.

Exchange integrity

The UNI-TE services uses a FIP message system data link level transmission and acknowledgment exchange.

5.1 First Start-Up of the Application

This procedure applies to a FIPIO fieldbus which has been wired using the procedure which ensures bus matching and continuity (refer to section 4, part D). It is used to detect any multiple address declarations.

1 Switch off the PLC and all the FIPIO devices,

2 For series 7, code address 0 on the PLC terminal block, connect the PLC to the bus and power up,

3 Code the address on the first device to be connected (read the label) and then power it up and connect it to the bus,

4 Check that the DEF LED (*) goes out. If the RUN, DEF (*), I/O and COM LEDs flash simultaneously after two seconds, then switch off the device and check the address coding because a device with this address is already connected to the bus,

5 Repeat points 3 and 4 for each device which is to be connected. Leave the devices that have already been connected continuously powered up.

5.2 Adding a Device to an Existing Application

1 Code the address on the first device to be connected (read the label) and then power it up and connect it to the bus,

2 Check that the DEF LED (*) goes out. If the RUN, DEF(*), I/O and COM LEDs flash simultaneously after two seconds, then switch off the device and check the address coding because a device with this address is already connected to the bus.

Important

TBXs must be powered up after the address has been coded since the new address is only taken into account after power up.

(*) ERR for sealtight TBX (IP65).

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1.1 General

Note :
In this document, the term segment means the part of the network between two repeaters or bridges, the term network means all the segments with the same network address and the term multiple network means an architecture comprising several interconnected networks.

The FIPWAY cell network is used mainly for level 1 applications such as coordinating all TSX and MPX PLCs, control and supervision systems and workshop terminals; FIPWAY can be used in setting up distributed automation control systems even if they are composed solely of TSX 17 micro-PLCs.

These applications are carried out by the set of devices that can be connected to the FIPWAY network :

- TSX 7 modular PLCs and PMX 7 model 40 PLCs,
- TSX 17 micro-PLCs,
- FTX 507 programming terminal,
- FTX 417 programming terminal,
- CCX 57/77 supervision and control system,
- PC-compatible terminal.

FIPWAY runs immediately without requiring configuration and supports all the communications services required by automation personnel with guaranteed refresh time, of the distributed database, network transparency and the UNI-TE message system services.

The FIPWAY cell network can be used in several ways :

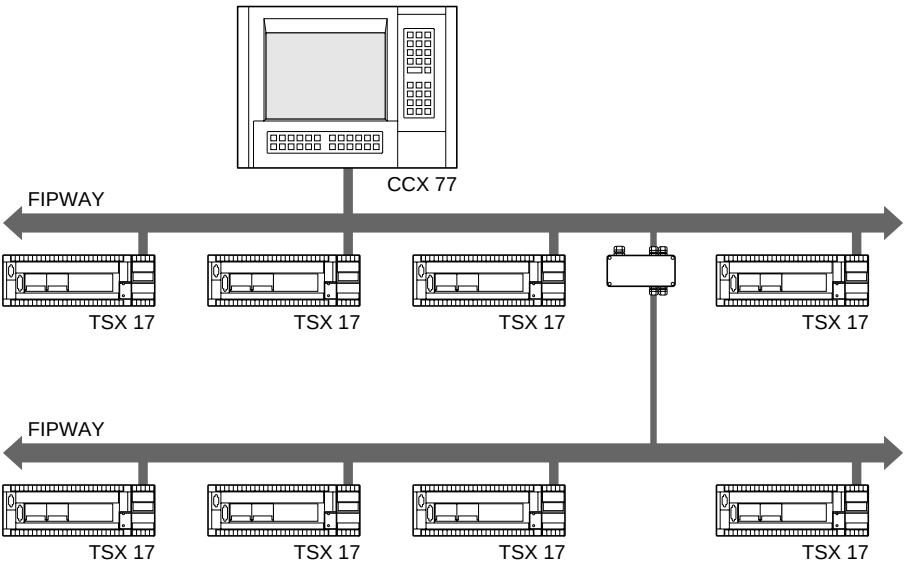
- In a simple environment (single network) with one segment,
- In a hierarchical environment (multiple network) where several segments can be connected in the workshop by a higher level local network such as MAPWAY, ETHWAY or MMS / ETHERNET.

The various architecture possibilities are shown on the following pages.

1.2 Examples

1.2-1 TSX 17 Single Network Architecture

Pumping System Automation Control System

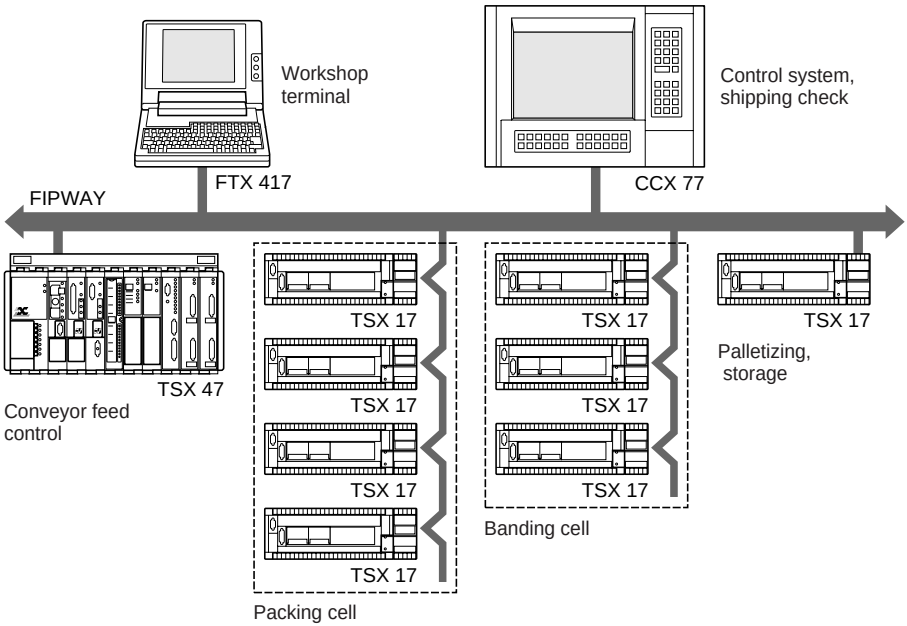


FIPWAY is designed for the low-cost automation of a geographically spread out site. The maximum permissible length is 5000 meters with the use of repeaters. All the TSX 17s in this type of architecture are part of the same network.

The type of cable used (twisted pair) and the exclusive use of TSX 17 micro-PLCs make this a particularly economical solution.

1.2-2 Single Network Architecture

Finished Product Packing Cell



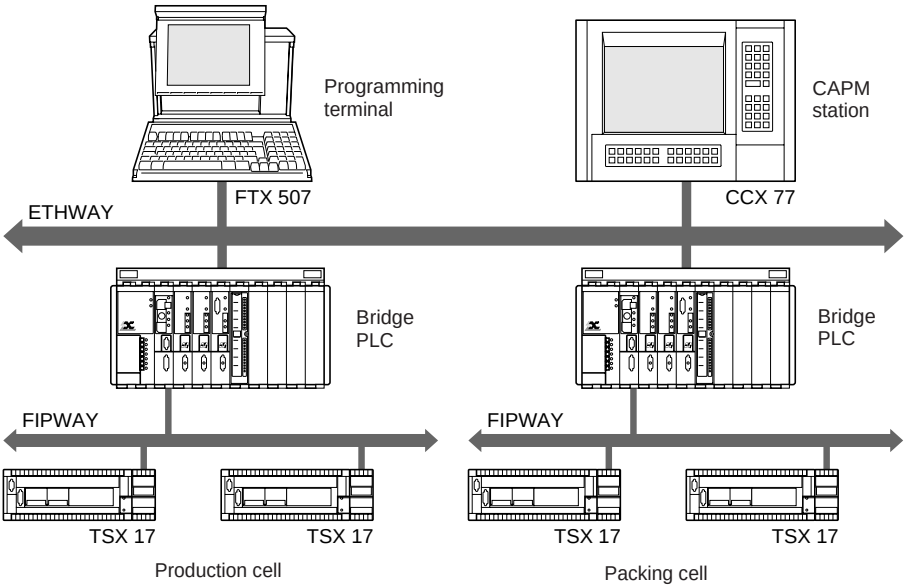
FIPWAY ensures the synchronization functions related to the handling of finished products at a reduced cost.

It enables simple machines such as banding machines or packing machines controlled by TSX 17 micro-PLCs to be connected.

The cell is controlled by a supervision system that is connected directly to the network. Information concerning shipping, statistics etc. are periodically sent to the control system.

1.2-3 Multiple Network Architecture

Production plant



In this type of hierarchical architecture, several FIPWAY cell networks are connected by the plant-wide ETHWAY network.

The transparency provided by this type of architecture carries production and distribution data to the Computed-aided Production Management (CAPM).

Similarly, all the functions of the X-TEL software workshop are supported by the stations connected to FIPWAY by means of ETHWAY / FIPWAY bridge PLCs.

2.1 General

A device connected to FIPWAY is identified by a unique address formed by the network number and the station number.

Network number

The network number takes the following values :

- 0 in single network layers,
- 1 to 127 in multiple network layers or in single network layers that may be connected later on.

Station number

The station number represents the physical address of the device on the network and takes a value between 0 and 63.

The network address/station address of a device connected to FIPWAY will build link layer addresses :

- To enable the device to address produced variables (broadcast),
- For addressing variables sent by the device or sent to the device.

Variable link addressing is performed via an identifier coded on a 16-bit integer. The application variables sent are common words (COM) which use the variable cyclic transfer link service.

Each link message sent contains the address of the source entity and the address of the target entity. Each address is coded on 24 bits.

FIPWAY offers two types of application messages :

- Telegrams which use the acknowledged messages cyclic transfer link service, (telegrams are always equivalent to point-to-point communication),
- Datagrams which use the aperiodic message transfer service. These messages are :
  - acknowledged if messages are sent in point-to-point mode,
  - not acknowledged if messages are sent in broadcast mode.

Bus arbiter

On a FIPWAY network at a given moment, a unique station authorizes data exchange : this is the active bus arbiter which controls access to that device.

The function of the bus arbiter is simple. It scrolls the list of cyclic exchanges of the variables and messages to be sent and then decides when the aperiodic exchanges of the variables and messages requested will take place.

The list of cyclic exchanges and the windows assigned for aperiodic traffic form a macro-cycle. The continuous scanning of this macro-cycle is performed by the active bus arbiter.

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On a FIPWAY network the macro-cycle is the same irrespective of the application program. The macro-cycle :

- Scans the telegrams sent by the stations with an address between 0 and 15 every 10 ms,
- Every 40 ms scans the common word variables sent by the stations with addresses between 0 and 31,
- Assigns a window for the aperiodic exchange of messages with a maximum of 210 messages of 128 bytes per second which will be shared between stations.

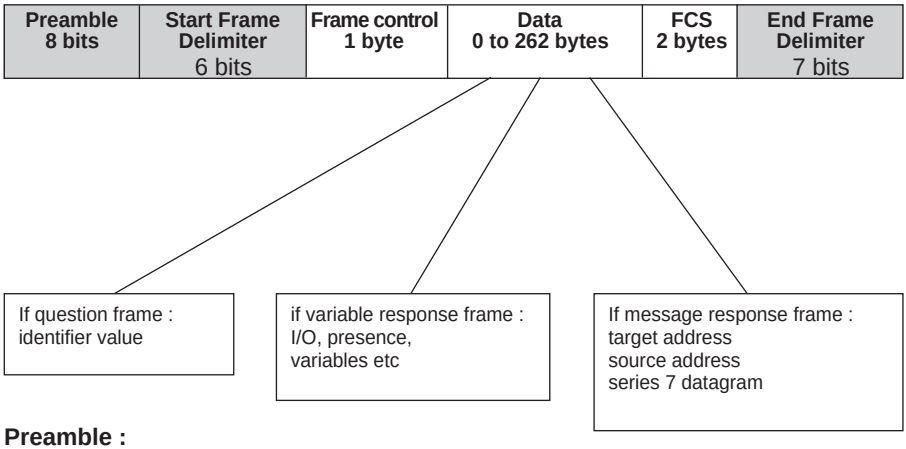
2.2 FIPWAY Exchange Format

The following information is not absolutely necessary when using FIPWAY. It is provided for familiar users as a brief explanation of how the network operates.

A FIPWAY exchange comprises two frame transfers :

- A question frame containing the identifier of the variable to send or the source entity of a message to send,
- A response frame containing the value of the identified variable or the application message sent on the bus.

The FIPWAY frame is broken down as follows :



Preamble :

This 8-bit string allows the receivers to synchronize to the clock of the source station.

Start frame delimiter :

This start frame delimiter comprises six bits and allows the date link layer to locate the start of its assigned data.

Frame control :

This byte tells you what type of frame has been exchanged :

- Question frame : identified variable, message or request,
- Response frame : identified variable, message acknowledged or not acknowledged, acknowledgment or request etc.

Data :

This field contains :

- The identifier value (two bytes) for a question frame,
- The value of the application variable (2 to 128 bytes) for an identified variable response frame,
- A source address (three bytes), a target address (three bytes) and a series 7 datagram (128 bytes) for a message response frame,
- A string of identifiers for a request response frame (system service).

FCS (frame check sequence) :

These two bytes are used to check that the data exchange is performed correctly. The control code is calculated by the source station and sent after the data. The receiving station recalculates the code and compares it with that received from the source. If the two do not match the message is refused by the target station.

End frame delimiter :

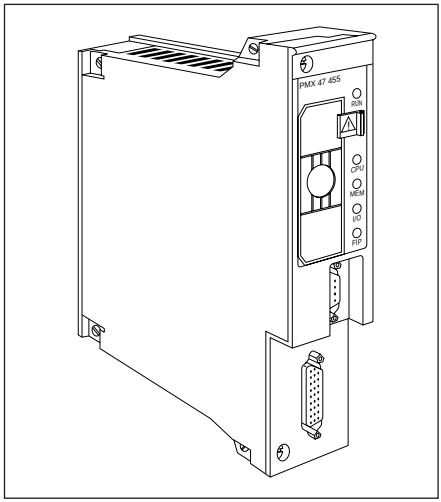
The end frame delimiter comprises seven bits and allows the data link layer to locate the end of its assigned data.

3.1 TSX and PMX Processors

The TSX P47-415 and TSX/PMX P47-455, P67-455, P87-455 and P107-455 processors are all equipped with a FIP link. The default operating mode of this link is FIPWAY.

The PLC processor is connected to the FIPWAY network via the TSX LES 65 or TSX LES 75 terminal block.

Each modular PLC supports a unique FIP connection as well as connection to the MAPWAY, TELWAY, UNI-TELWAY, ETHWAY or MMS/ETHERNET networks.



These PLC processors run the following services :

- Bus arbiter election system,
- Common word distributed database comprising 0 to 4 COM words for address stations 0 to 31 (stations with a network address higher than 31 neither produce nor consume common words),
- UNI-TE client and server (maximum of 128 bytes exchanged) for stations with addresses 0 to 63,
- Application-to-application communications using text function blocks (maximum of 128 bytes exchanged) for stations with addresses 0 to 63,
- Priority application-to-application communications using telegram function blocks (maximum of 16 bytes exchanged) for stations with addresses 0 to 15.

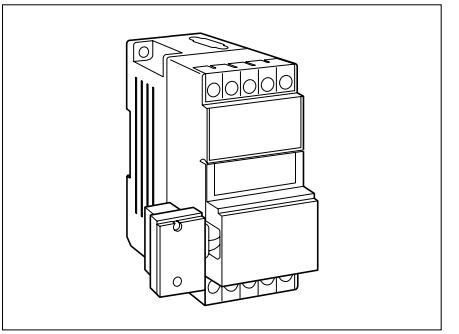
For more information on the description and functions of the FIP link built into the processors, refer to the Model 40 Processor Manual.

3.2 TSX FPG 10 Module

This module is used to connect TSX 17-20 micro-PLCs equipped with the PL7-2 V5 language micro-software cartridge.

A TSX FP ACC SUB-D 9-point male connector is used to connect this module to the FIPWAY network by means of an extension or drop line.

This module is the same standard format (52 mm) as the TSX 17 extension modules and connects to the base PLC or to the previous extension block by a cable built into the module.



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The micro-PLCs only support one FIPWAY network connection as well as a UNI-TELWAY connection.

The micro-PLCs support the following services :

- Bus arbiter election system,
- Common word distributed database comprising O to 4 COM words for stations with addresses 0 to 15 (TSX 17 stations with a network address higher than 15 neither produce nor consume common words),
- UNI-TE server (maximum of 32 bytes exchanged) for stations with addresses 0 to 62,
- Application-to-application communications using text function blocks (maximum of 32 bytes exchanged) for stations with addresses 0 to 62.

Note :

The simultaneous use of the services offered by a TSX 17-20 module (COM, UNI-TE and application-to-application communication services) implies that the module has a station address no higher than 15.

For more information on the use of this module, refer to the FIPWAY TSX FPG 10 Module User's Manual.

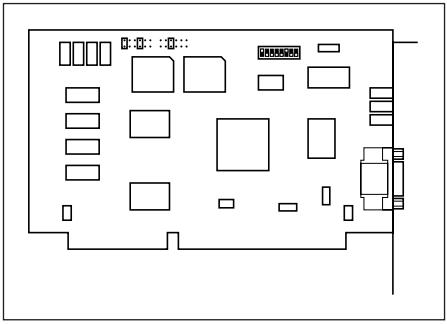
3.3 TSX FPC 10 Module

This module is used to connect the following to FIPWAY :

- FTX 507 programming terminals,
- CCX 57/77 supervision systems,
- Any machine equipped with a PC AT bus running on DOS 3.1 or higher or OS/2 1.1 or higher.

The TSX FP CE 030 cable and the TSX FP ACC4 tap are used to connect the above devices to a FIPWAY segment.

This module is a half-size PC extension board. It slides into one of the slots on the bus.

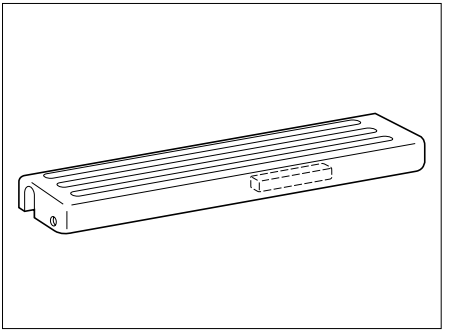


A FIP OS/2 driver, a FIP DOS driver and an Installation Manual are provided with this module.

Once connected to FIPWAY, the programming terminals can access all the stations on the network layer. The X-TEL software workshop can therefore run the whole network architecture and its constituent stations.

For more information on this module refer to the TSX FPC 10/20 User's Manual.

3.4 TSX FPC 20 Module



This module is used to connect the FTX 417 programming terminal running on DOS 3.3 or higher or OS/2 1.1 or higher.

The TSX FP CE 030 cable and the TSX FP ACC4 tap are used to connect the above devices to a FIPWAY segment.

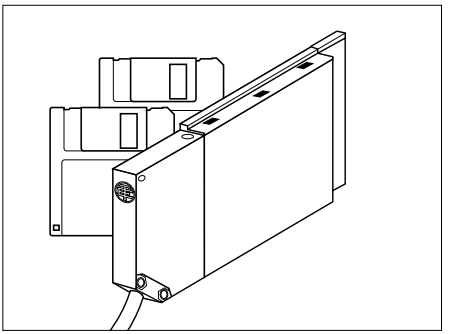
This module comprises an element (case and board) which slides into the slot provided in the FTX 417 terminal.

A FIP OS/2 driver, a FIP DOS driver and an Installation Manual are provided with this module.

Once connected to FIPWAY, the programming terminals can access all the stations on the network layer. The whole network architecture and its constituent stations can then be used.

For more information on this module refer to the TSX FPC 10/20 User's Manual.

3.5 TSX FPP K 200M PCMCIA type III card



The module is used to connect the FTX 417-40 notebook to the FIPWAY network under DOS or OS/2.

It consists of :

- 1 FIPWAY PCMCIA TSX FPP 20 PCMCIA card,
- 1 set of DOS and OS/2 driver 3"1/2 diskettes.

A TSX FP CG 010/030 connection cable (1 or 3 m long) is used for connection to the TSX FP ACC4 tap.

Using a FIPWAY connection, the FTX 417-40 notebook can access all stations in an X-WAY architecture. It is also possible to perform the complete setup of the network and the stations which are connected to it.

The TSX FPP K 200M module is used for connecting a PC-compatible which has a PCMCIA type III slot.

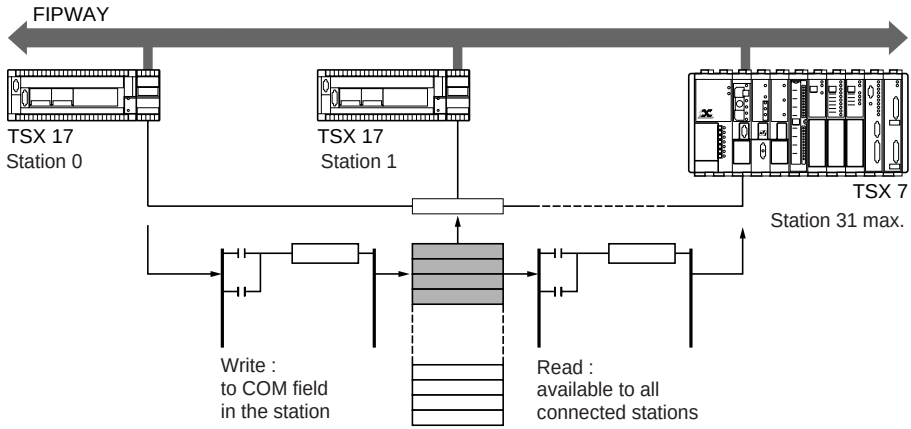
4.1 COM Service

FIPWAY supports the TSX series 7 COM (common) word service. The complete set of COM words forms a database that is distributed among some or all of the devices connected to the same segment of the network :

- The database comprises 256 words of 16 bits (four words per station),
- Only stations with addresses 0 to 31 (0 to 15 TSX 17-20 PLCs) handle common words,

Principle of operation

The common words are exchanged automatically in cyclic mode without intervention from the application program. The complete database on a network is updated every 40 ms.
Use of the distributed COM word database is recommended for the periodical sending of status variables without adding extra application program workload. To send data on brief events, application-to-application communication with a confirm is recommended as transmission is guaranteed.



The PLCs using the COM word service must enable their COM word activity when being configured. For more information on configuration refer to the PL7-3, V5 Operating Modes Manual for model 40 PLCs and to PL7-3 V5/X-TEL Operating Modes Manual for TSX 17-20 PLCs.

4.2 UNI-TE Service

The FIPWAY network supports AEG Schneider Automation's UNI-TE industrial message system protocol. UNI-TE enables point-to-point communications using a question and answer dialog called Request/Confirm.

Dialog sequencing

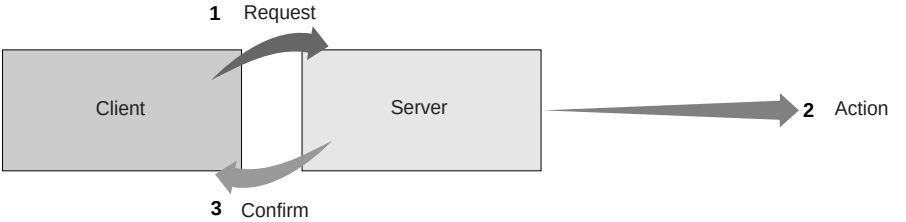
A device that supports the UNI-TE protocol can be a :

CLIENT : This device initiates communication. It asks a question (reads), sends a command (writes) or an order (Run, Stop etc.).

SERVER : This device executes the order sent by the client and sends a confirm after execution.

The services supported depend on the type of device, e.g. PLC, programming terminal, supervision system. Depending on its function, each device can be a Client and/or a Server. TSX 17-20 PLCs are only servers on UNI-TE.

The maximum size of the messages is 128 characters (32 characters for TSX 17-20 automates).



UNI-TE is especially suited to applications such as supervision, diagnostics and control.

Exchange integrity

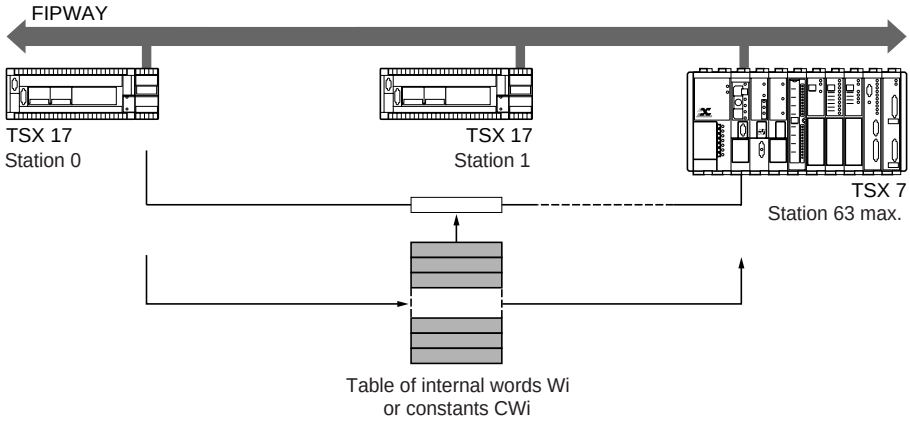
The UNI-TE service uses a FIP message system data link level transmission and acknowledgment exchange.

4.3 Application-to-Application Communication

FIPWAY also supports communication between applications in point-to-point mode by TXT block. This service is the same as the UNI-TE Unsolicited Data service and does not provide a confirm.
This service is especially suited to :

- Sending alarm messages from a PLC to a supervision system,
- Exchanging data tables between two PLCs under the control of the application programs in the source and target device,

The maximum size of application-to-application messages is restricted to 128 characters (32 characters for PSX 17-20 PLCs) for both reading and writing.



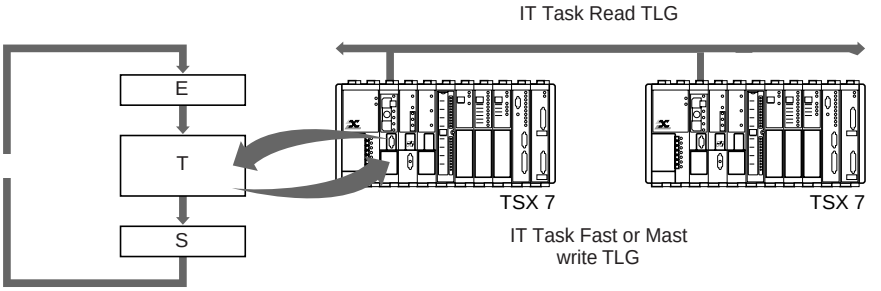
4.4 Priority Communication : Telegram

The telegram service is a special type of application-to-application message designed to transmit occasional urgent and high priority data between two PLCs on the same network segment.

A telegram from the PLC processor to its network module is processed immediately without waiting for the end of the PLC cycle.
It can be received by :

- Scanning the fast task,
- Sending an interrupt (as soon as the message reaches the target network module) and processing in the interrupt task.

The maximum size of messages sent using this service is restricted to 16 bytes.



Note

Only TSX and PMX 47-455, 67-455, 87-455 and 107-455 PLCs support the telegram service. It is restricted to stations with addresses 0 to 15.

5.1 Characteristics

Structure

Type : FIP-standard open industrial network.

Topology : Devices connection in extension or drop mode.

Access Method : Controlled by a bus arbiter.

Dedicated exchanges : Telegrams, common words and UNI-TE messages.

Transmission

Mode : Base band physical layer on shielded twisted pair (French standard NF C46 604).

Binary data-rate : 1 Mb/s.

Medium : Shielded twisted pair (impedance 150 Ohms).

Configuration

Nbr of stations : 32 stations per segment (maximum of 64 for all segments).

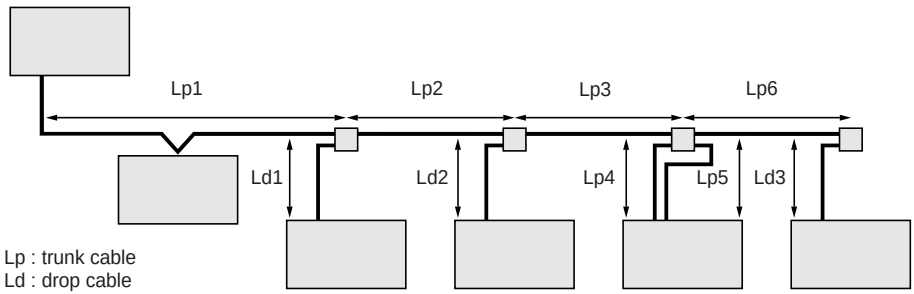
Nbr of segments : A maximum of 5 (cascaded) using electrical or optical repeaters. (maximum of 4 cascaded).

Length : The length of a segment depends on the type of its drop connections. Maximum permissible length is 1000 meters without a repeater for a segment and 5000 meters between end devices (5 segments).

Multiple network : 127 FIPWAY, MAPWAY, TELWAY, ETHWAY, or MMS/ETHERNET connected together.

Drops : These connections are made through the use of taps, drop cables or loop-back of the trunk cable. If a drop cable is used, the length of the drop is equal to three equivalent trunk cable lengths. The length of a segment is therefore equal to :

$$L = \text{sum of } Lpx + 3 \times \text{sum of } Ldx \leq 1000 \text{ m}$$



Services

COM : Distributed database of a maximum of 128 words (4 words per station). It comprises :
- Model 40 PLCs using 0 to 4 common words for stations with addresses 0 to 31,
- TSX 17-20 micro-PLCs using 0 or 4 common words for stations with addresses 0 to 15.

UNI-TE : Point-to-point request service with confirm, 128 bytes maximum and can be used by all the stations.
- The maximum size of messages is 128 bytes for model 40 PLCs,
- The maximum size of messages is 32 bytes for TSX 17-20 micro-PLCs.

Application-to-application : Point-to-point message service of a maximum of 128 bytes that can be used by all the stations.
- The maximum size of these messages is 128 bytes for model 40 PLCs,
- The maximum size of these messages is 32 bytes for TSX 17-20 micro-PLCs.

Telegram : Point-to-point priority message system (maximum of 16 bytes). Only model 45 PLCs support this service. Access is restricted to stations with addresses 0 to 15.

Data integrity : Control characters on each frame with acknowledgment of point-to-point messages using French standard NF C46 603.

Supervision : Network status accessible via FTX 507, CCX 57, CCX 77, FTX 417 or PC-compatible terminals running NETDIAG software.

Maximum size of information sent

Variables : 128 bytes.

Messages : 128 bytes.

Message data-rate: 210 128-byte messages per second.

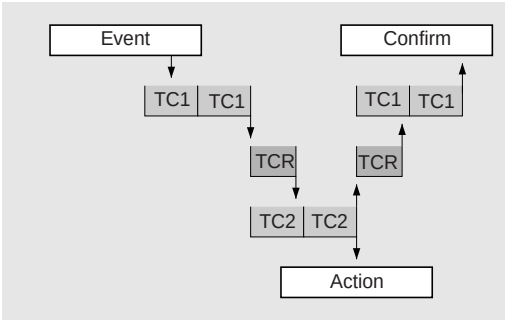
5.2 Performance

FIPWAY ensures guaranteed and constant cycle time for a given configuration, irrespective of the amount of traffic and the number of stations (2 to 64). A FIPWAY installation can evolve (stations added or deleted) without compromising performance.

Maximum transmission time

- Telegrams (TLG)
  Priority application messages are sent in less than 10 ms (1 TLG per station).
- Common words (COM)
  The complete common word database is updated every 40 ms.
- UNI-TE message system (TXT)
  UNI-TE or standard application-to-application messages are generally sent in less than 80 ms (40 ms for stations with a network address lower than 32). If considerable traffic is circulation on the network, some messages can wait several cycles before being sent. The network can send a maximum of 210 128-byte messages per second.

These network characteristics mean that the application response time depends exclusively on the processing capacity of the connected devices. A 50 Kword program can be downloaded in less than two minutes on a network with a normal workload.



Response time must be assessed by application designers taking into account the connected devices.

The processing time of a device may be one or two cycle times depending on the asynchronous mechanisms used.

6.1 First Start-Up of the Application

This procedure applies to a FIPWAY network which has been wired using the procedure guaranteeing bus matching and continuity (refer to section 4, part D).

1 Switch off all the FIPWAY devices,

2 Code the address of a device and then connect it to the network and power it up,

3 Code the address on the next device and then connect it to the network and power it up,

4 Check that the DEF LED goes out. If the RUN LED flashes continuously, switch off the device and check the address coding because a device with this address is already connected to the bus,

5 Repeat points 3 and 4 for each device which is to be connected. Leave the devices that have already been connected continuously powered up.

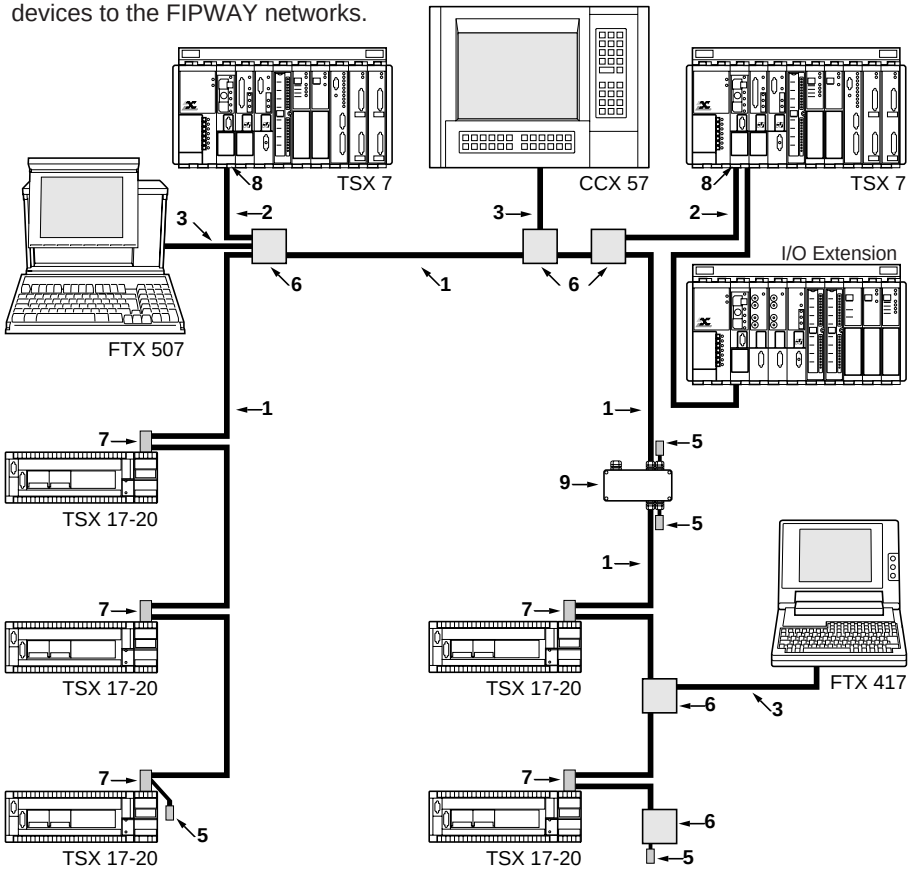
6.2 Adding a Device to an Existing Application

1 Code the address on the device to be connected and then connect it to the network and power it up,

2 Check that the DEF LED goes out. If this LEDs flashes continuously, switch off the device and check the address coding because a device with this address is already connected to the bus.

1.1 FIPWAY Network Connection Accessories

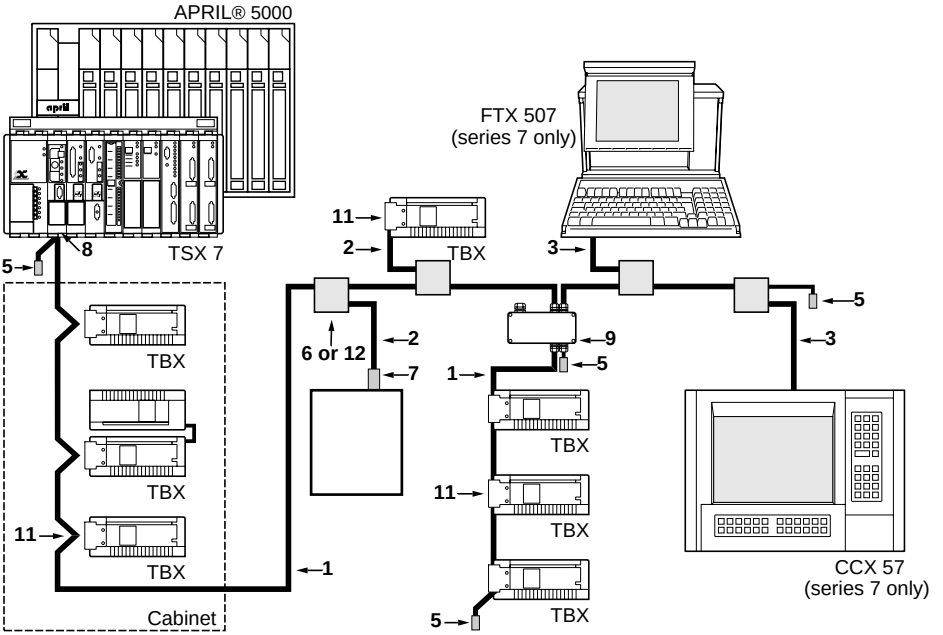
AEG Schneider Automation offers a range of accessories for connecting the various devices to the FIPWAY networks.



1 TSX FP CA/CRxxx : Trunk cable,
2 TSX FP CCxxx : Drop cable,
3 TSX FP CE030 : Connector cable for terminals and PC,
5 TSX FP ACC7 : Line terminator,
6 TSX FP ACC4 : Tap,
7 TSX FP ACC2 : Extension or drop cable connector,
8 TSX LES 65/75 : Terminal block for modular PLC,
9 TSX FP ACC6 : Electrical repeater,
TSX FP ACC9 : Tool for testing the wiring system.

1.2 FIPIO Bus Connection Accessories (IP20)

AEG Schneider Automation offers a range of accessories (IP20) for connecting the various devices to the FIPIO bus. These are the same as those used for FIPWAY. Only the TBX BLP 01 connector is a FIPIO dedicated connector.



1 TSX FP CA/CRxxx : Trunk cable (1a or 1b),
2 TSX FP CCxxx : Drop cable,
3 TSX FP CE030 : Connector cable for terminals and PC (3a),
or KIT5130 : APRIL 5000 cord (3b),
5 TSX FP ACC7 : Line terminator,
6 TSX FP ACC4 : Tap,
7 TSX FP ACC2 : Extension or drop cable connector,
8 TSX LES 65/75 : Terminal block for modular PLC,
9 TSX FP ACC6 : Electrical repeater,
11 TBX BLP 01 : TBX connector,
14 TBX FP ACC10 : Tap,
TSX FP ACC9 : Tool for testing the wiring system.

1.3 Description of the Different Accessories

1a TSX FP CA xxx trunk cable

This 8-mm diameter 150 Ohm cable comprises a shielded single twisted pair. It is available in 100-, 200- or 500-meter spools with outer insulation made of black PVC. It is used to connect the various devices to the FIPWAY/FIPIO network either directly or by using TSX FP ACC4 taps. The D+ wire insulation is red and D- insulation is green. The characteristics of the trunk cable are provided in the Appendix, part E, section 1.4.1.

1b TSX FP CR xxx trunk cable for harsh environments for sealtight TBX modules

This 150 Ohm flexible cable, approximately 9.3 mm in diameter, comprises a single shielded twisted pair. It is available in 100-, 200- or 500-meter spools. It is used to connect devices to the FIPWAY/FIPIO network either directly or using TSX FP ACC4 taps. Its characteristics enable it to be used in mobile installations or subject to particular environmental constraints (out of doors, chemical corrosion, etc.). The D+ wire insulation is orange and the D- insulation is black.

2 TSX FP CC xxx drop cable

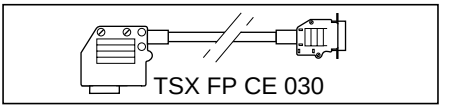
This 8-mm diameter 150 Ohm cable comprises two shielded twisted pairs. It is available in 100-, 200- or 500-meter spools with outer insulation made of black PVC. It is used for drop connections made from a TSX FP ACC4 tap.
The trunk cable length to take into account for network calculations is three times the physical length of the drop cable. The "electric" length of a drop connection is three times its physical length. The insulation of the D+ wires is red and orange and that of the D- wires is green and black. The characteristics of the drop cable are provided in the Appendix, part E, section 1.4.3.

TSX FP CR trunk cable, diameter 8.5 mm, is a shielded twisted pair. Its characteristics are identical to those of the TSX FP CF.

3a TSX FP CE 030 cord

This cord comprises 3-meter long shielded multiple pair cable with a connector fitted to each end : a 15-point connector for connection to the terminal and a 9-point connector for connection to the network. It is used to connect FTX 507, FTX 417, CCX 7 and PC-compatible terminals to the FIPWAY/FIPIO network. The terminal must be fitted with a TSX FPC 10 network interface module (for FTX 507, CCX 7 or PCs equipped with an ISA bus) or a TSX FPC 20 module (for FTX 417).

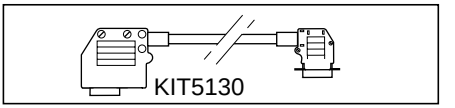
A TSX FP ACC4 or TBX FP ACC10 tap must be used for connection to the bus.



3b KIT5130 cord

This cord is electrically identical to the TSX FP CE 030 cord above, and only differs in the shape of the 9-point connector. It is right-angled, making it possible to close the door of the APRIL 5000 processor module.

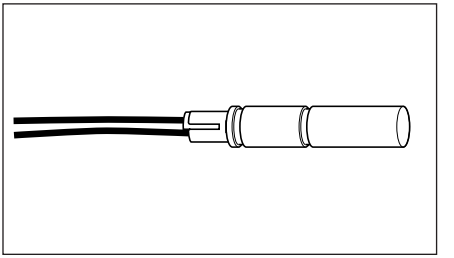
A TSX FP ACC4 or TBX FP ACC10 tap must be used for connection to the bus.



5 TSX FP ACC7 line terminator

This line terminator is used for matching FIPWAY/FIPIO segments.

A line terminator must therefore be placed at both ends of each bus segment. It is unpolarized and can be connected to all TSX LES 65 or 75, TSX FP ACC2/ACC4/ACC6, TBX BLP 01 or TBX BLP 10 connection accessories in place of the second segment of the trunk cable.

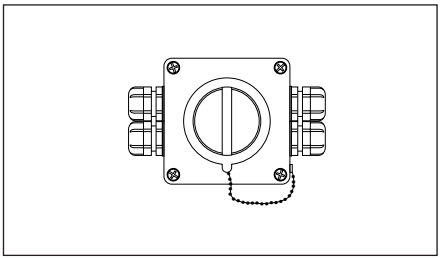


6 TSX FP ACC4 tap

The **sealtight** tap is used for drop connections of devices to the FIPWAY/FIPIO network.

It is also equipped with a 9-point female connector and via the TSX FP CE 030 or KIT5130 cord (excluding cords fitted with male 9-point connectors), will connect :

- a terminal in which a TSX FPC 10/20 or a PCMCIA TSX FPP 10/20 board has been mounted,
- an APRIL 5000 PLC.



The operation of the network is not affected by the connection or disconnection of the terminal. The different cables are connected by screw terminal blocks (one terminal block for each twisted pair). The tap provides protection to IP54 standard and allows cables to be fed through cable glands of the same standard. The connection socket on the terminal can be accessed once the quarter-turn protection cap has been removed. The resulting protection number is IP 21. The TSX FP ACC4 tap can be fitted with a TSX FP ACC7 line terminator.

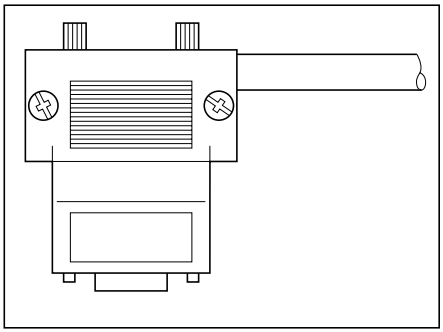
D

7 TSX FP ACC2 connector

This connector is used to connect devices fitted with standard physical interfaces (TSX 17-20 etc.) by means of extension or drop cables to the FIPIO/FIPWAY network.

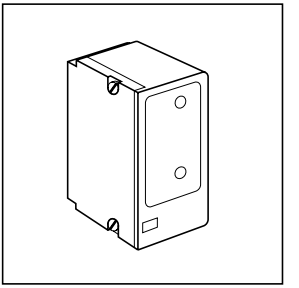
A screw terminal is used for this operation. Full connection compatibility is ensured with TSX FP CA/CRxxx and TSX FP CCxxx cables.

The TSX FP ACC2 connector can be fitted with the TSX FP ACC7 line terminator.



8 TSX LES 65 or 75 connection box

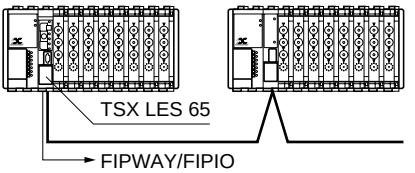
This box which is connected to the front of series 7 processors is equipped with a FIP port and is used to connect the PLC to the FIPWAY/FIPIO network.



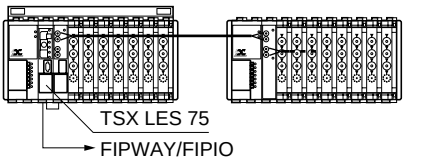
The TSX LES 65 and TSX FP 75 connection boxes can be fitted with the TSX FP ACC7 line terminator if the configuration of the PLC at the end of the segment does not have a remote or local extension. If these extensions are installed, the TSX FP ACC7 line terminator must be mounted in the TSX FP ACC4 tap.

In the case of local or remote extensions via optical fibers, the base rack must be connected using a drop connection.
Depending on the type of extension used, the choice of a TSX LES 65 or 75 tap is as follows :

Local extension



Optical or electrical remote extension (example of optical fiber)



This connection box is equipped with two sets of micro-switches which are used to code the network address (NET) and the station address (STA). See the next page.

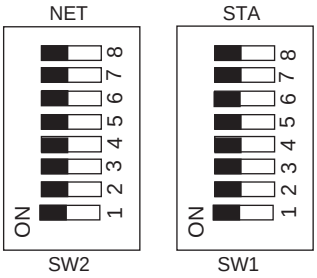
Important note :

Each micro-switch is assigned a binary order. Micro-switch 8 is assigned binary order 1, micro-switch 7 binary order 2, etc. and micro-switch 1 is assigned binary order 128.

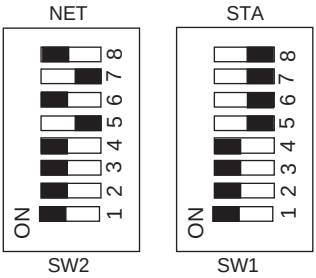
A micro-switch set to ON corresponds to binary order 0.

If a PLC is configured for connection to FIPIO, it must have a unique address on the bus. This address must be 0. To do this, all the STA and NET micro-switches must be set to ON.

FIPIO example

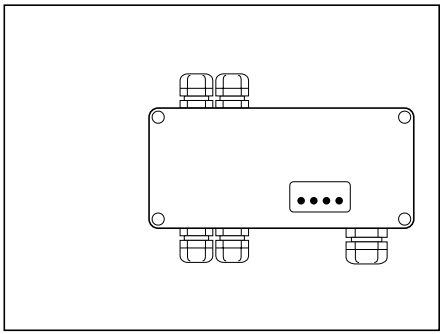


Network 10 and Station 15 example



9 TSX FP ACC6 electrical repeater

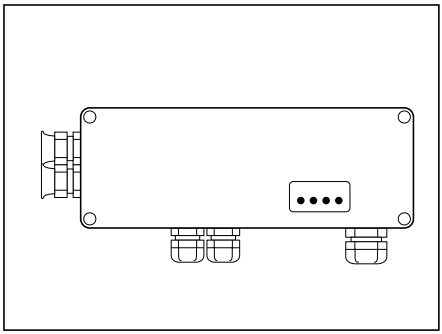
This sealtight module is used to connect two FIPWAY/FIPIO segments, thus increasing the length of the network. Linear or tree-type topologies are obtained in this way and the number of devices able to be connected to the network is also increased (a maximum of 64 logical connections on the complete network). By using several repeaters, the maximum network length is 5000 meters.



Screw terminals are used to connect the various cables. This module uses 24 V DC (150 mA) or 48 V DC (75 mA) which is connected to a special terminal block. Four LEDs indicate that this terminal block is operating correctly. The TSX FP ACC6 repeater provides protection to IP65 standard and allows cables to be fed through cable glands of the same standard. It can be fitted with TSX FP ACC7 line terminators.

10 TSX FP ACC8 optical / electrical repeater

This sealtight module is used to connect electrical cells (FIPWAY/FIPIO segments), whose earth cannot be made equipotential, and which are further than 1000 m / 3000 m maximum apart and/or separated by areas with high levels of interference.
By using optical /electrical repeaters, as with electrical repeaters, the number of devices on FIPWAY/FIPIO can be increased (64 logical connections max.) as well as the length (5000 m max.).



The optical / electrical repeater uses a 24 V DC or 48 V DC supply. Four LEDs indicate that this terminal block is operating correctly.

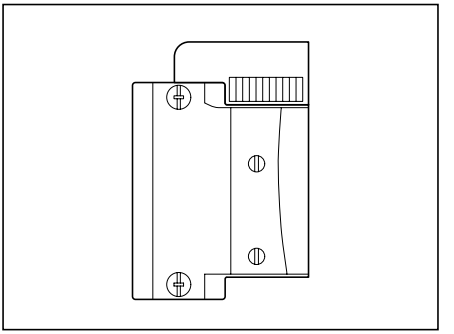
A 2 m long optical cable (optical jumper) TSX FP JF 020 enables :

- the TSX FP ACC8 to be used as an interface between a FIP optical station and a FIPWAY/FIPIO segment,
- the TSX FP ACC8 to be connected to an optical cable mixer enclosure.

Characteristics and performance : see Appendix 4, part E.

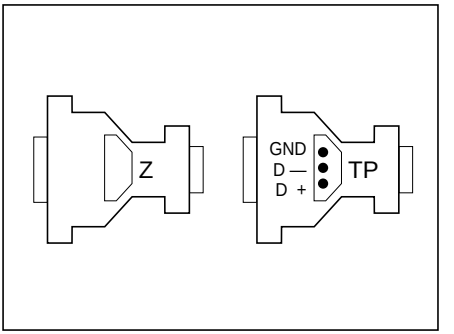
11 TBX BLP 01 connector

This connector is used to connect the TBX remote I/O interfaces to the FIPIO bus using an extension or drop cable. Full compatibility is ensured with TSX FP CA/CRxxx and TSX FP CCxxx cables.
The TBX BLP 01 connector can be fitted with a TSX FP ACC7 line terminator.



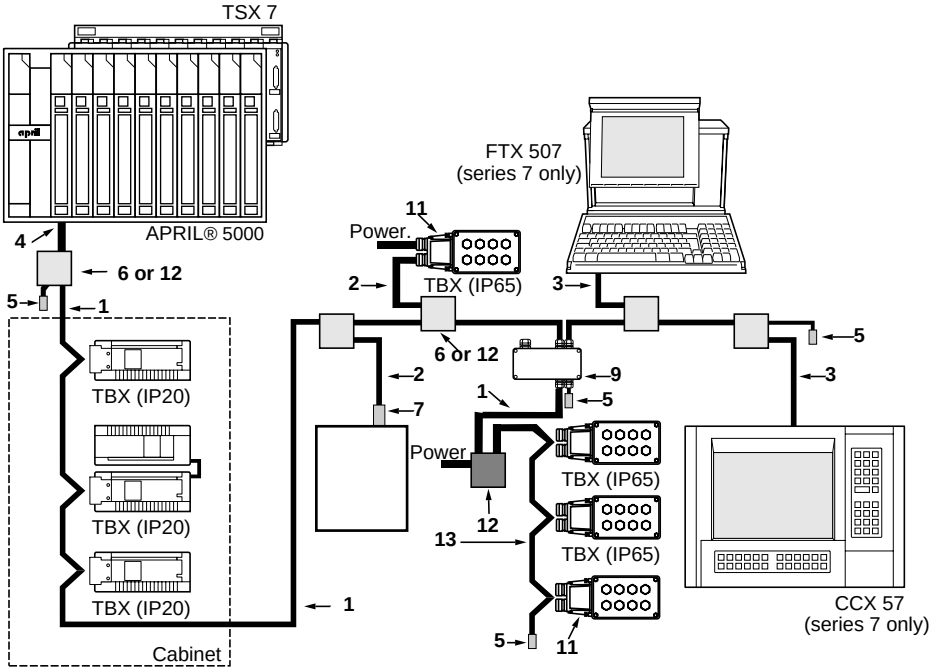
12 FIP TSX FP ACC9 wiring test tool

This tool is used to test each segment in the network (network continuity, line terminators mounted, etc.). It comprises two modules, Z and TP.



1.4 FIPIO Bus Connection Accessories (IP65)

AEG Schneider Automation offers a range of sealtight accessories (IP65) for connecting the various devices to the FIPIO bus.



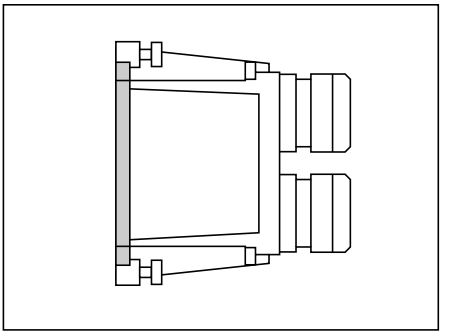
1 TSX FP CA/CRxxx : Trunk cable, (1a or 1b),
2 TSX FP CCxxx : Drop cable,
3 TSX FP CE030 : Connection cable for terminals and PC,
4 KIT5130 : APRIL 5000 cord,
5 TSX FP ACC7 : Line terminator,
6 TSX FP ACC4 : Tap,
7 TSX FP ACC2 : Extension or drop cable connector,
8 TSX LES 65/75 : Terminal block for modular PLC,
9 TSX FP ACC6 : Electrical repeater,
13 TBX BLP 10 : TBX connector (IP65),
14 TBX FP ACC10 : Tap,
15 TSX FP CFxxx : Remote power cable

TSX FP ACC9 : Tool for testing the wiring system.

1.5 Description of the Different Accessories (IP65)

13 TBX BLP 10 (IP65) connector

This connector is used to connect the TBX remote I/O interfaces to the FIPIO bus by using an extension or drop cable. Full compatibility is ensured with TSX FP CFxxx and TSX FP CCxxx cables.
The TBX BLP 10 connector can be fitted with a TSX FP ACC7 line terminator.



Note :
All connection accessories for TBX (IP20) interfaces can be used to connect TBX (IP65) interfaces, with the exception of the TBX BLP 01 (see section 1.3, part D).

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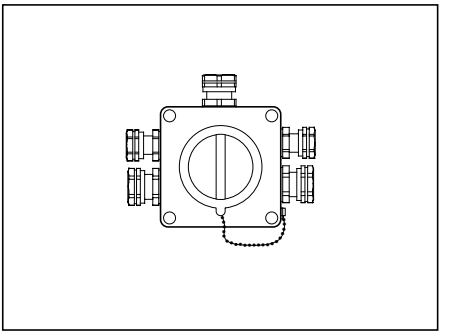
14 TBX FP ACC10 tap

This sealtight tap has the same functions as the TSX FP ACC4 tap (see section 1.3, part D).

It is also enables the 24 V DC module power supply to be connected.

The supply is carried via the remote power cable TBX FP CFxxx.



15 Remote power cable

This flexible cable, diameter approximately 9.5 mm, consists of a single shielded twisted pair, characteristic impedance 150 Ohm, and a power supply pair. It is available in 100-, 200- or 500-meter spools. It is used to connect IP65 TBX to FIPIO. Its characteristics enable it to be used in mobile installations or those which are subject to particular environmental constraints (out of doors, chemical corrosion, etc.). For the shielded twisted pair, the insulation of the D + wire is orange, and that of the D - wire is black. For the power supply pair, the insulation of the + wire is pink, and that of the - wire is blue.

2.1 Principles

A network can evolve, e.g. lengthening the trunk cable, connecting additional devices or taps. Precise network calculations and a complete network design file will be invaluable when planning any future changes to the network. This file will also be useful when performing maintenance.

Three rules must be observed when designing the wiring for a FIPWAY/FIPIO network :

- Determine the number of electrical segments comprising the network,
- Check that the right number of devices are connected to the network,
- Determine the number of line terminators.

2.1-1 Determining the Number of Electrical Segments

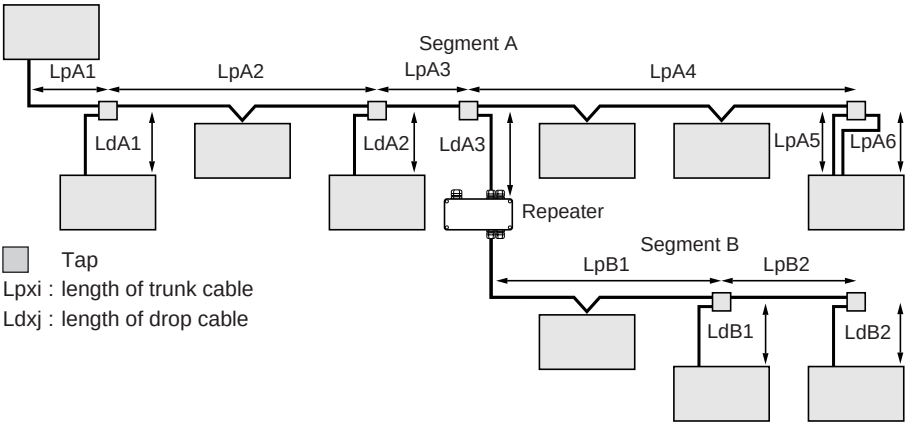
When designing a FIPWAY/FIPIO network, the following rule applies :

The maximum length of an electrical segment including the taps is 1000 meters of equivalent "trunk cable".

The network designer must take into account the type of connections used (extension or drop connections using drop cable or trunk cable etc.) The drop connections carried out using TSX FP CE030 or KIT5130 cables (for connecting programming terminals, etc.) are not to be allowed for when calculating the length of FIPWAY/FIPIO segments.

- When TSX FP CCxxx drop cables are used (drop cable with two twisted pairs) the length of trunk cable equivalent to the drops is three times the length of the drop connections. For example, if the sum total of the drop connections is 150 meters, the maximum length of trunk cable will be 550 meters (550 = 1000 - 3*150).
- When TSX FP CA/CRxxx trunk cables are used (a single twisted pair), the device on the drop connection must be connected to the TSX FP ACC4 or TBX FP ACC10 connection box by two cables, one for each direction (see part A, section 2.2-3). The length of trunk cable equivalent to the drop connections is therefore twice the length of these drops. If, for example, the sum total of the drop connections is 150 meters, the maximum length of trunk cable will be 700 meters (700 = 1000 - 2*150).

Example :



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The length of segment A, shown by the relation below must always be shorter than 1000 meters :

L segment A = ∑LpAi + 3∑LdAj

The length of segment B, shown by the relation below must always be shorter than 1000 meters :

L segment B = ∑LpBi + 3∑LdBj

If the length of a cable is calculated to be longer than 1000 meters, an additional segment must be created and connected via an electrical repeater.

2.1-2 Maximum Number of Devices

Rules :

A maximum of 32 devices and four repeaters can be connected to the same segment.

The TSX FP ACC4 and TBX FP ACC10 taps are not considered as devices.

A programming terminal or a supervision system connected via a TSX FP CE 030 cable to a TSX FP ACC4 or TBX FP ACC10 tap is considered as a device.

If more than 32 devices are to be connected, one or more additional segments must be created so that the above-mentioned rule can be applied.

2.1-3 Line Terminators

For matching purposes an electrical segment must be fitted with a TSX FP ACC7 line terminator at both ends.

Line terminators are sold in lots of two. A lot is required for each electrical segment.

Each line terminator can be connected to any wiring element :

TSX LES 65 or 75, TSX FP ACC2/ACC4/ACC6, TBX FP ACC10, TBX BLP 01/10.

Section 3.5, part D gives a description of each of these elements for fitting the TSX FP ACC7 line terminators.

3.1 Installing the Cables

Different cables must be used for internal and external applications.

The following table gives the cable references and shows which cables should be used for which environmental conditions.

3.1-1 Cable usage criteria (Except sealtight TBXs)

The table below shows standard and severe operating conditions.

Application	**Inside building**		**Outside building**	
Operating conditions	**Trunk cable**	**Drop cable**	**Trunk cable**	**Drop cable**
Standard, without special precautions fixed installation	TSX FP CAxxx	TSX FP CCxxx	TSX FP CRxxx	TSX FP CRxxx
Resistance to hydrocarbons, industrial oils, detergents	TSX FP CRxxx	TSX FP CRxxx	TSX FP CRxxx	TSX FP CRxxx
Resistance to solder splashes	TSX FP CRxxx	TSX FP CRxxx	TSX FP CRxxx	TSX FP CRxxx
Up to 100% humidity with significant variations in temperature -10°C < θ°C < 70°C	TSX FP CRxxx	TSX FP CRxxx	TSX FP CRxxx	TSX FP CRxxx
Mobile installations	TSX FP CRxxx	TSX FP CRxxx	TSX FP CRxxx	TSX FP CRxxx
Other specific conditions	Ask your Regional Sales Office			

See Sections : A 2.3-2 and A 2.3-3 for tap connections using TSX FPCCxxx and TSX FPCRxxx cables.

3.1-2 Special case of sealtight TBXs

The drop connection of sealtight TBXs requires a FIP cable with an additional remote power supply pair. In all cases, indoors or out of doors, use cable reference TSX FP CF xxx.

Note : If the cables are stored in rolls and not on drums, unravel the cable from the outer edge of the roll, in order to avoid subjecting the cable to severe mechanical stress.

3.1-3 Installation rules

It is however necessary, as it is with all industrial networks, to observe strict installation rules to ensure full network performance. Special care must be taken to **observe the rules set out in the manual Recommendations for PLC Installation Wiring.**

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As well as complying with the rules in the above-mentioned document, the following must be observed :

- Firstly, ground the wiring system (protection), starting from a TSX FP ACC4 tap that has been mounted properly and connected to the grounding network.
- All FIPWAY/FIPIO segments must be fitted at each end with TSX FP ACC7 line terminators (segment adapters). No terminators (or too many terminators) will cause communication failures.

Each screw terminal of the FIPWAY/FIPIO wiring system must be used.
Each one must be connected to one wire only.

Never modify the wiring system without completely shutting down the application.

The connectors (terminal plugs, device plugs etc.) can be disconnected when the power is on.

3.2 Installing Connection Accessories

3.2-1 Fastening

Installing the TSX FP ACC4 or TBX FP ACC10 tap

This tap can be secured to an AM1 PA... mounting grid or to an AM1 DE/DP top hat rail with an LA9 D09976 fastening plate.

Installing a TSX FP ACC6 or TSX FP ACC8 repeater

The repeater can be secured to an AM1 PA... mounting grid or to an AM1 DE/DP top hat rail with an LA9 D09976 fastening plate.

Installing the TSX FP CE 030 or KIT5130 cord on the TSX FP ACC4 or TBX FP ACC10 tap

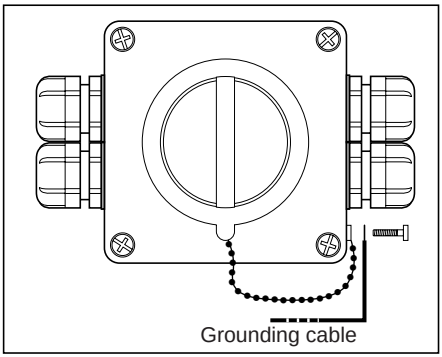
To connect this cord, remove the quarter-turn cap on the top part of the tap to access the connector. Make sure that the cord is secured by tightening the two knurled knobs.

3.2-2 Grounding

Each connection accessory is electrically connected to the other ones through the cable shielding. Therefore, the first operation to carry out is to ground the first installation accessory.

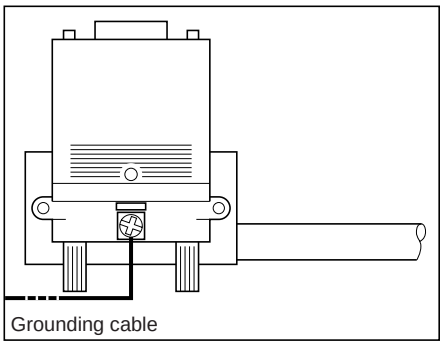
Grounding the TSX FP ACC4 and TBX FP ACC10 taps

These taps should be secured using conducting screws and fan-type lockwashers to a conducting metal support that is part of the grounding network. If there is not enough contact (painted support) they can be grounded via the screw located at the bottom right-hand side of the tap. This screw also secures the quarter-turn cap. A short cable (2.5 mm^2 or more) is required.



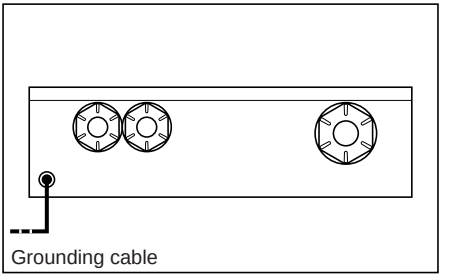
Grounding the TSX FP ACC2, TBX BLP 01 or TBX BLP 10 connectors

Although the connector boxes are different, the grounding principle is the same. The example shown opposite corresponds to the TSX FP ACC2. The grounding screw is on the back of the connectors.



Grounding the TSX FP ACC6 or TSX FP ACC8 repeater

The connection and grounding principle is the same as for the TSX FP ACC4 tap. If the DC power supply cord is equipped with a ground connector and/or shielding, connect to the terminal with the ⏚ symbol.
The power supply cable shielding will not ground the TSX FP ACC6/ACC8 repeater.



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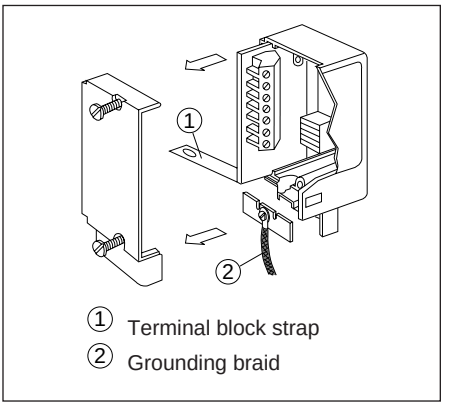
Grounding TSX LES 65/75 connection boxes

The TSX LES 65/75 connection box grounding braid must be connected to the TSX RAC 20/20W11/25 grounding strip (fixed to the lower part of model 40 PLC racks).

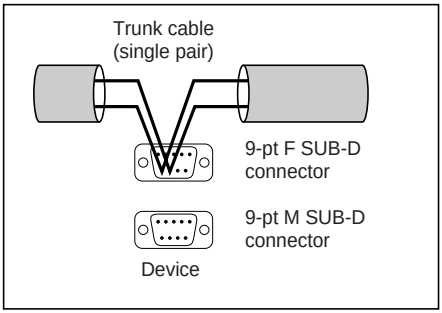


3.3 Wiring the Bus

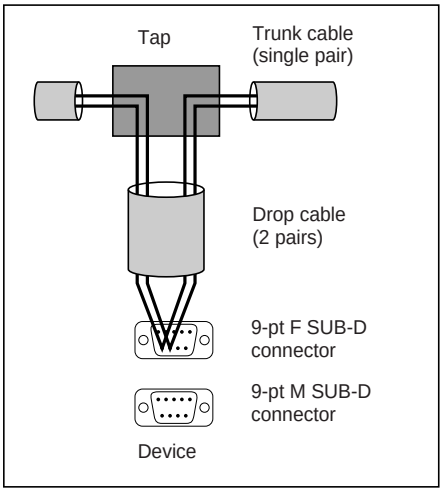
Connection principles

Devices can be connected to FIPWAY/ FIPIO in two ways : extension and drop.

The electrical physical layer of the FIP standard does not support "pure electrical drops". All FIPWAY/FIPIO devices are connected electrically to the closest shielded twisted pair.

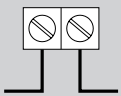


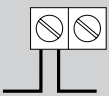
If the installation requires a drop, it is obtained by looping back the electrical pair. This results in a "topological" drop of this cable.



For each connection accessory, each wire is connected to a special screw terminal.

Irrespective of the type of connection used (extension or drop), never screw two FIPWAY/FIPIO wires to the same terminal.


Right


Wrong

D

3.4 Preparing the cables

Prepare each cable (trunk or drop) as illustrated in the diagrams so that the shielded twisted pairs in the different connection accessories can be connected :

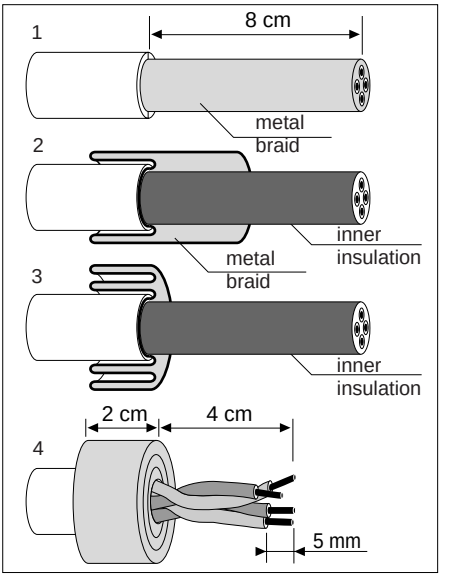
Wiring the TSX LES 65 and TSX LES 75 Connection Terminals

1 Strip the cable approximately 8 cm,

2 Fold back the metal braid over the outer insulation as shown in the diagram,

3 Fold back the metal braid a second time over itself and cut the inner insulation,

4 Cut the wires so that they are approximately 4 cm in length and then strip each of the wires to expose 5 mm and mount the fittings supplied.



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Wiring the TSX FP ACC2, TBX BLP 01 connection accessories and the TSX FP ACC4, TBX FP ACC10, TSX FP ACC6, TSX FP ACC8 devices.

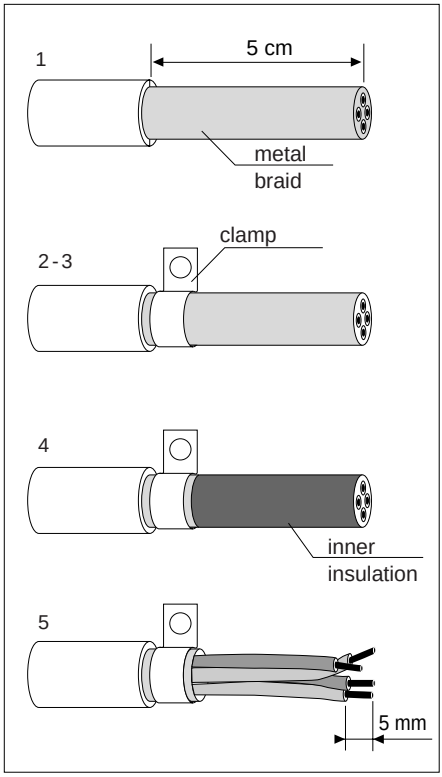
1 Strip the cable approximately 5 cm,

2 Cut the metal braid near the clamp,

3 Mount the grounding clamp, (the place where the clamp is mounted on the cable must take into account how it is secured to the connector, either to the right or to the left of the cable),

4 Cut the inner insulation and the neutral-colored rings to expose the wire,

5 Strip each of the wires approximately 5 cm and mount the terminators supplied.



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3.5 Connecting the Different Accessories

When installing the FIPWAY/FIPIO electrical segments, the connection of each wiring system accessory must be checked before connecting the next one. Section 4 describes the test procedure to be performed. Make sure the grounding rules are applied (refer to section 3.2-2).

3.5-1 Connecting the TSX LES 65 and TSX LES 75 Connection Boxes

FIPWAY/FIPIO cables are connected by means of a screw terminal block. The links to the extensions are connected through connector JF. The procedure is as follows :

1 Open the connection box,

2 To access the screw terminal block, slide the board out of the box,

3 Prepare the cables as described on the previous pages and then screw each wire into the screw terminal block, observing wire pairing and polarity : Red (+) / Green (-) and Orange (+) / Black (-). The wiring diagrams below show the different types of connection possible i.e. extension or drop connection,

4 Put the board back in the box,

5 Place the cable(s) under the grounding bar and tighten,

6 Remove the blanking caps on the cover to expose the cableways,

7 Refit the cover and tighten.

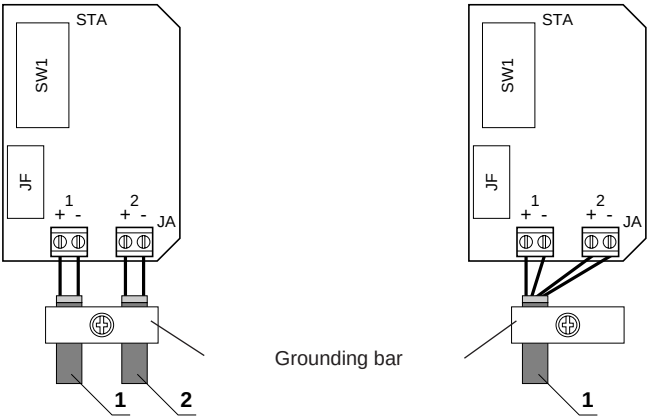
D

Extension connection

If the PLC is placed at the start or the end of a FIPWAY/FIPIO segment, only cable **1** is connected to the connection box. In this case, cable **2** must be replaced by an unpolarized TSX FP ACC7 line terminator.

Drop connection

In the diagram cable **1** is a TSX FP CCxxx drop cable. If the drop is achieved by 2 TSX FP CA/CRxxx cables, connect in the same way as for extension connection.



3.5-2 Connecting TSX FP ACC2 Connectors

The different cables are connected by means of a screw terminal block. The procedure is as follows :

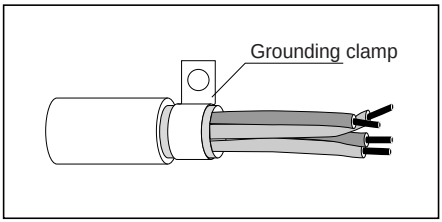
1 Open the connection box,

2 Prepare the cables as described on the previous pages and then screw each wire into the screw terminal block, observing wire pairing and polarity : Red (+) / Green (-) and Orange (+) / Black (-). The wiring diagrams below show the different types of connection possible, i.e. extension or drop connection,

3 Secure the grounding clamp(s) into the connector, taking care not to pinch the wire,

4 Remove the blanking caps on the cover to expose the cableways,

5 Refit the cover and tighten.

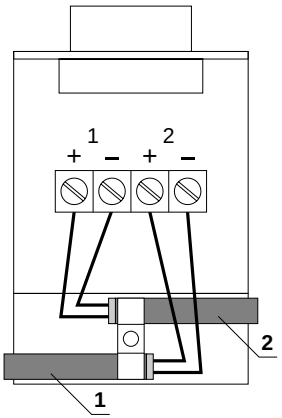


Extension connection

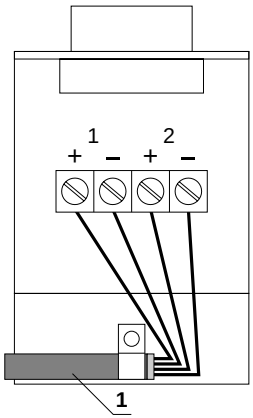
If the device equipped with the connector is placed at the start or the end of a FIPWAY segment, only cable **1** is connected to the connection box. In this case, cable **2** must be replaced by an unpolarized TSX FP ACC7 line terminator.

Drop connection

In this diagram cable **1** is a TSX FP CCxxx drop cable. If the drop is achieved by 2 TSX FP CA/CRxxx cables, connect in the same way as for extension connection.



The securing of the grounding clamp means that the incoming cable feeders cannot be placed opposite each other. They must be on the same side (right or left) or one above the other.



In this type of configuration, the cable can arrive either from the right or the left or from the top or bottom.

3.5-3 Connecting the TSX FP ACC4 Taps

The various cables are connected by means of a screw terminal block. A separate terminal block is used for each twisted pair. The procedure is as follows :

1 Open the tap,

2 Prepare the cables as explained earlier and feed them through the cable glands,

3 Fit a grounding clamp to each cable. The position of the clamp on the cable must take into account its fastening in the connection box (on the right-hand or left-hand side of the cable),

4 Screw each wire into the screw terminal block. Comply with wire pairing and polarity : Red (+) / Green (-) and Orange (+) / Black (-),

5 Tighten the grounding clamps and then tighten any cableways in which a cable or line terminator is located,

6 Refit the cover and fasten.

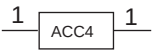
D

The TSX FP ACC4 tap is also equipped with a 9-point female connector which, via the TSX FP CE 030 or KIT5130 cord (excluding all other cords equipped with 9-point male connectors), connects terminals fitted with a TSX FPC 10/20 board, a TSX FPP 10/20 PCMCIA card or a series 1000 processor.

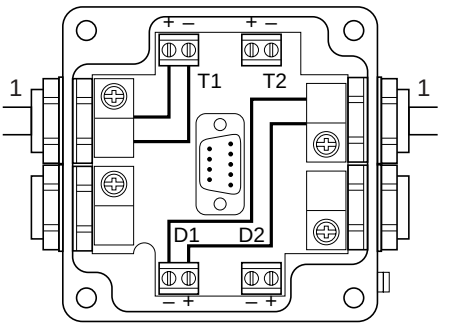
The diagrams on the following pages illustrate the various types of connection possible :

- Tap without drop connection,
- Drops connected using a drop cable,
- Connection to a TSX/PMX PLC with line terminator,
- Drops connected using the trunk cable,
- Connection of a TSX FP ACC7 line terminator.

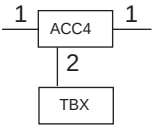
- **Tap without drop connection**



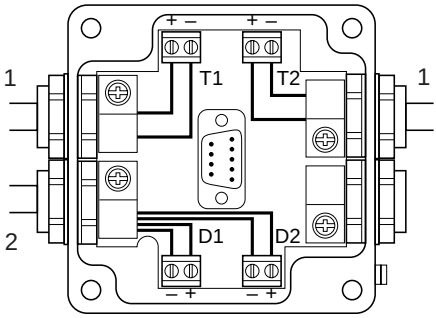
If a tap is waiting to be connected (no drop wired), the trunk cable must be connected as shown in the diagram opposite. The user can connect a programming terminal to the SUB-D connector, once the quarter-turn cap has been removed.



- **Drops connected with the TSX FP CCxxx drop cable**

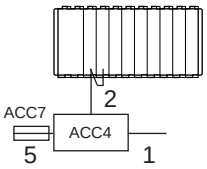


The drops must be connected as shown opposite. The user can also connect a programming terminal to the SUB-D connector, once the quarter-turn cap has been removed.

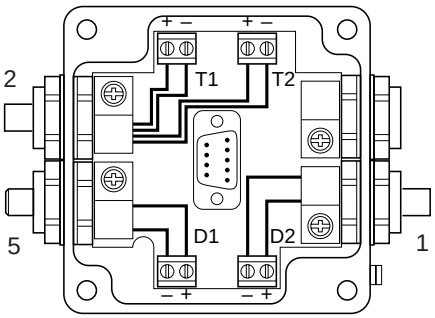


In the example, the drop cable comes out of the cable gland on the left. The right-hand cable gland can also be used.

- **Connecting to a TSX/PMX PLC with line terminator**



The TSX LES 75/65 connector (on a TSX/PMX processor) and the TSX FP ACC4 tap are connected using a TSX FP CCxxx drop cable.



The TSX FP CA/CRxxx trunk cable (on D2) corresponds to the beginning or the end of a segment, the line terminator is at D1 (or vice versa).

The 2nd connection on the TSX LES 75/65 connector is reserved for the link to the adapter module TSX LES 120/LFS 120/LFS 121.

1 TSX FP CA/CRxxx trunk cable,

2 TSX FP CCxxx drop cable,

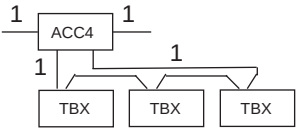
5 TSX FP ACC 7 line terminator.

(+) corresponds to the red or orange wire,

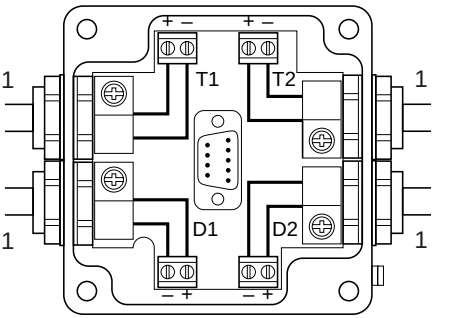
(-) corresponds to the green or black wire,

D

- **Drops connected with the TSX FP CA/CRxxx trunk cable**



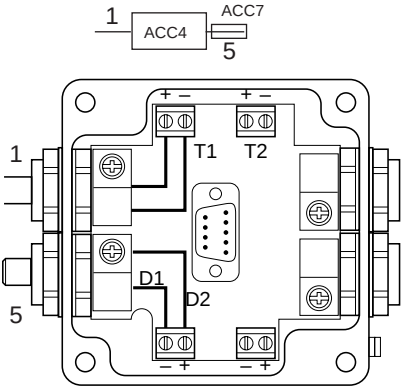
The drops must be connected as shown opposite. The user can also connect a programming terminal to the SUB-D connector, once the quarter-turn cap has been removed.



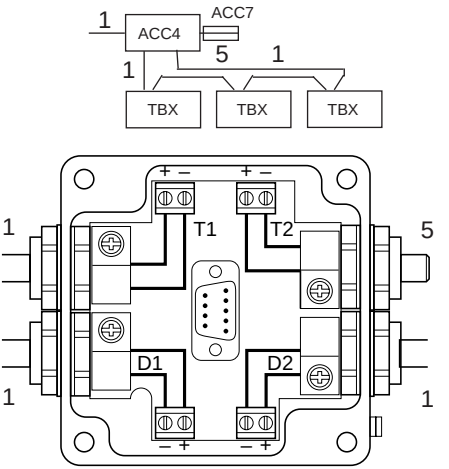
- **Connecting a TSX FP ACC7 line terminator**

If a tap is located at the beginning or at the end of a segment only the T1 cable is connected and a TSX FP ACC7 line terminator (unpolarized) is connected in the place of the second cable segment.
The type of connection depends on whether the drop connection is wired or not as illustrated in the diagrams below. The user can connect a programming terminal to the SUB-D connector, once the quarter-turn cap has been removed.

Tap without drop connection



Tap with drop connection



1 TSX FP CA/CRxxx trunk cable,

5 TSX FP ACC7 line terminator,

(+) corresponds to the red or orange wire,

(-) corresponds to the green or black wire. TSX FP ACC7 line terminator.

3.5-4 Connecting the TBX FP ACC10 Taps

The various cables are connected by means of a screw terminal block. A separate terminal block is used for each twisted pair. The procedure is as follows :

1 Open the tap,

2 Prepare the cables as described earlier,

3 Remove the card,

4 Feed the power cable through the cable gland,

5 Connect the protective ground cable to the inside of the connection box (a terminal is provided for this),

6 Connect the power cables to the terminal block on the component side observing polarities,

7 Replace the card,

8 Feed the other cables through the appropriate cable glands,

9 Fit a grounding clamp to each cable. The position of the clamp on the cable must take into account where it is fastened in the connection box (on the right-hand or left-hand side of the cable),

10 Screw each wire into the screw terminal block, observing wire pairing and polarity : Red (+)/Green (-), Orange (+)/Black (-) and pink (+)/blue (-).
FIPIO is connected to the +,- terminal blocks T1, T2, D1, D2
The remote power cable is connected to the +, - terminal block (not named).

11 Tighten the grounding clamps and then tighten any cableways in which a cable or line terminator is located, **(tightening torque : 3 Nm for large diameter cable glands, 2.5 Nm for small diameter cable glands),**

12 Refit the cover and fasten.

The TBX FP ACC10 tap is also equipped with a 9-point female connector which, via the TSX FP CE 030 or KIT5130 cord (excluding all other cords equipped with 9-point male connector), connects terminals fitted with a TSX FPC 10 or TSX FPC 20 board or a series 1000 processor.

Caution :

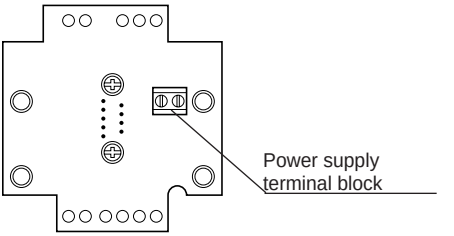
To maintain the index of protection (IP65) when TBX FP ACC10 is not fully equipped, it is essential to fit sealtight plugs to the cable glands not in use **(tightening torque of 1 Nm for cable glands).**

The diagrams on the following pages illustrate the power supply wiring and the various types of connection possible :

- Tap without drop cable,
- Drops connected with the drop cable,
- Drops connected with the trunk cable,
- Drops connected using the remote power cable,
- Connection of a TSX FP ACC7 line terminator.

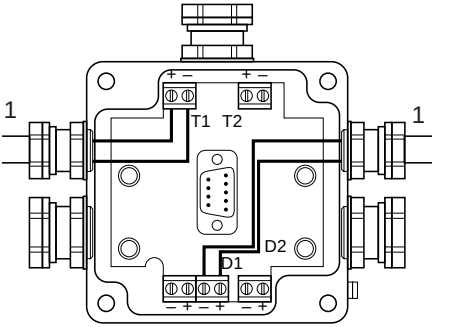
- **Power supply wiring**

The power supply terminal block of the connection box is located on the component side of the board.
The remaining terminal blocks used for other types of connections are located on the other side of the board.

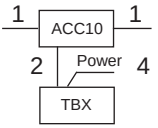


- **Tap without drop connection**

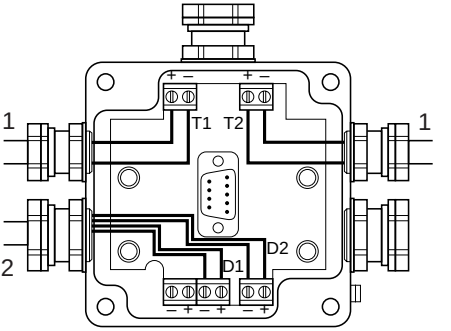
If a tap is waiting to be connected (no drop wired), the trunk cable must be connected as shown in the diagram opposite. The user can connect a programming terminal to the SUB-D connector, once the quarter-turn cap has been removed.



- **Drops connected with the TSX FP CCxxx drop cable**



The drops must be connected as shown opposite. The user can also connect a programming terminal to the SUB-D connector, once the quarter-turn cap has been removed. In the example, the drop cable comes out of the cable gland on the left. The right-hand cable gland can also be used.



1 TSX FP CA/CRxxx trunk cable,

2 TSX FP CCxxx drop cable,

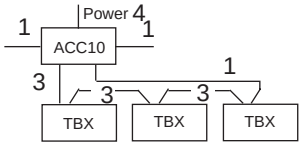
4 Power supply cable,

(+) corresponds to the red or orange wire,

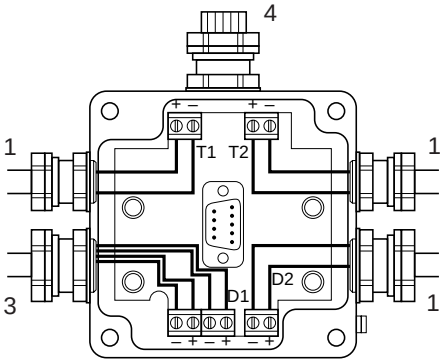
(-) corresponds to the green or black wire.

D

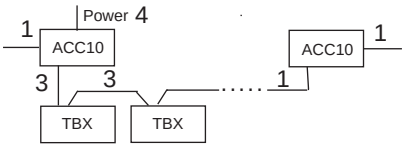
- **Drops connected with the TSX FP CA/CRxxx trunk cable**

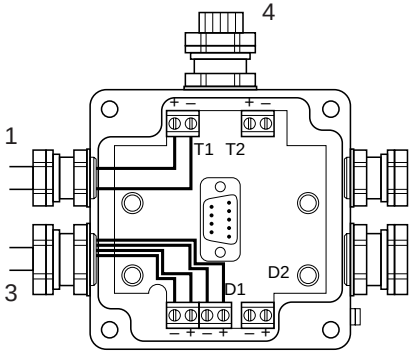


The drops must be connected as shown opposite. The user can also connect a programming terminal to the SUB-D connector, once the quarter-turn cap has been removed.



- **Extension**





1 TSX FP CA/CRxxx trunk cable,

3 TBX FP CCxxx or TSX FP CF for IP 65 tap and power supply cable,

4 Power supply cable,

(+) corresponds to the red or orange wire of the FIPIO network for T1,T2,D1,D2 and to the pink wire for power supply to the remote power cable,

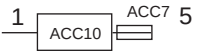
(-) corresponds to the green or black wire of the FIPIO network for T1,T2,D1,D2 and to the blue wire for power supply to the remote power cable.

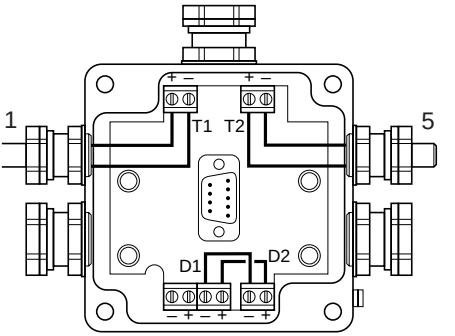
- **Connecting a TSX FP ACC7 line terminator**

  If a tap is located at the beginning or at the end of a segment only the T1 cable is connected and a TSX FP ACC7 line terminator (unpolarized) is connected in the place of the second cable segment.

  The type of connection depends on whether the drop connection is wired or not, as illustrated below. The user can connect a programming terminal to the SUB-D connector, once the quarter-turn cap has been removed.

Tap without drop connection





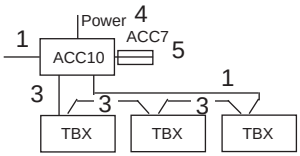
1 TSX FP CA/CRxxx trunk cable,

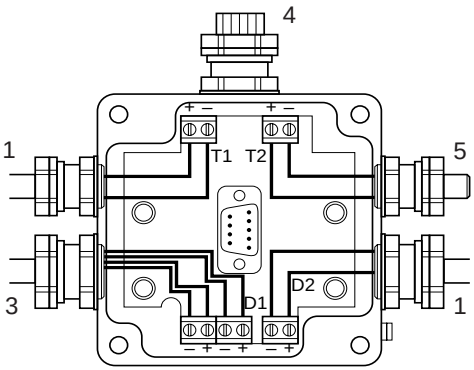
5 TSX FP ACC7 line terminator,

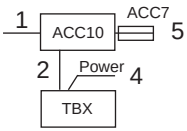
(+) corresponds to the red or orange wire,

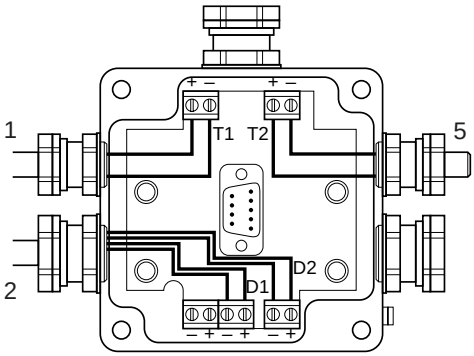
(-) corresponds to the green or black wire.

Tap with drop connection









1 TSX FP CA/CRxxx trunk cable,

2 TSX FP CCxxx drop cable,

3 TBX FP CFxxx drop and power supply cable,

4 Power supply cable,

5 TSX FP ACC7 line terminator,

(+) corresponds to the red or orange wire of the FIPIO network for T,T2,D1,D2 and to the pink wire for power supply to the remote power cable,

(-) corresponds to the green or black wire of the FIPIO network for T1,T2,D1,D2 and to the blue wire for power supply to the remote power cable.

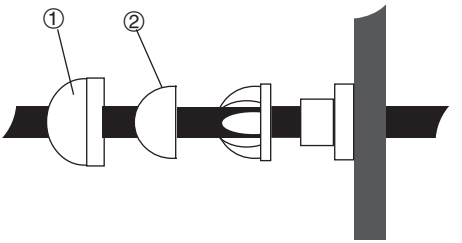
3.5-5 Connecting the TSX FP ACC6 Repeater

The various cables are connected by means of a screw terminal block. For the DC power supply unit, any round cable can be used that is equipped with two or three 2.5 mm^2 wires. If a shielded cable is used, the shielding should be connected to the terminal with the following symbol ⏚

The procedure is as follows :

1 Open the repeater,

2 Prepare the cable glands concerned by cutting the seal ② in the nut ①. Place each cable in a cable gland. If using a line terminator then proceed in the same way. When reassembling take care that all cable gland pieces are replaced correctly,



3 Prepare the cables as described earlier,

4 Mount a grounding clamp on each network cable (shielded twisted pair). The position of the clamp on the cable must take into account its fastening in the connection box (on the right-hand or left-hand side of the cable),

5 Tighten the grounding clamps and then tighten any cable glands which contain a cable, taking great care that the cable does not turn round on itself when tightening the cable gland,

6 Screw each wire into the screw terminal block, complying with wire pairing and polarity : Red (+) / Green (-) and Orange (+) / Black (-). The wiring diagrams on the following pages show the different types of connection possible, i.e. extension or drop,

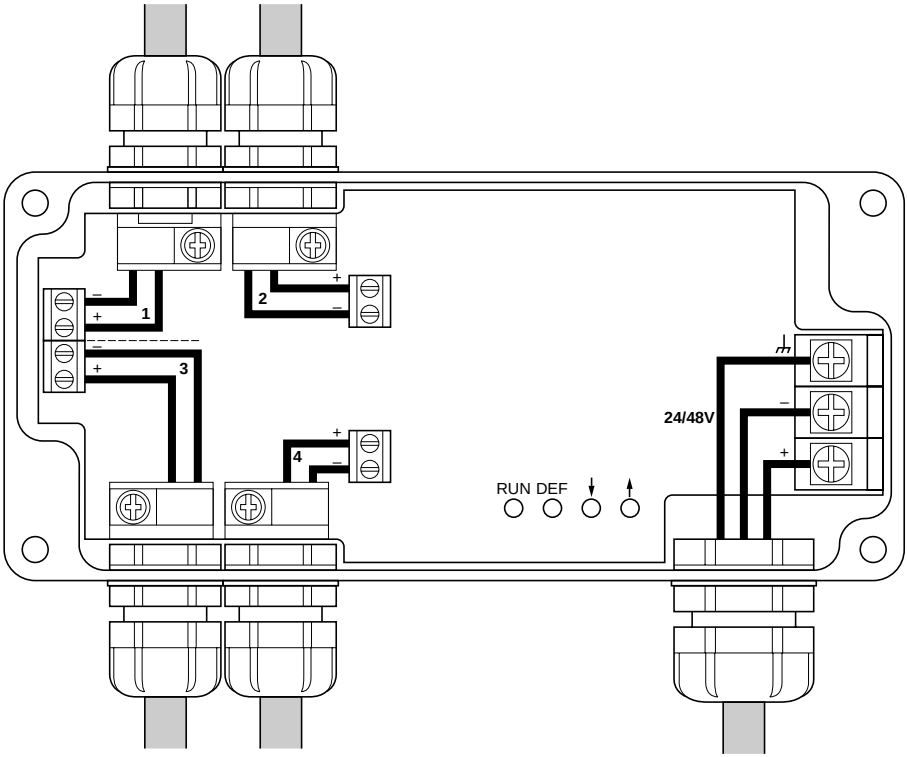
7 When using a line terminator, attach a grounding clamp to the TSX FP ACC7, tighten the cable gland, and screw each wire into its screw terminal,

8 Refit the cover and fasten.

Drop connection

If the repeater is located at the beginning or at the end of FIPWAY/FIPIO segment A, only cable ① is connected. In this case cable ② must be replaced by a TSX FP ACC7 line terminator. Similarly, if the repeater is located at the beginning or at the end of segment B, only cable ③ is connected and cable ④ is replaced by an unpolarized TSX FP ACC7 line terminator.

Segment A



Segment B

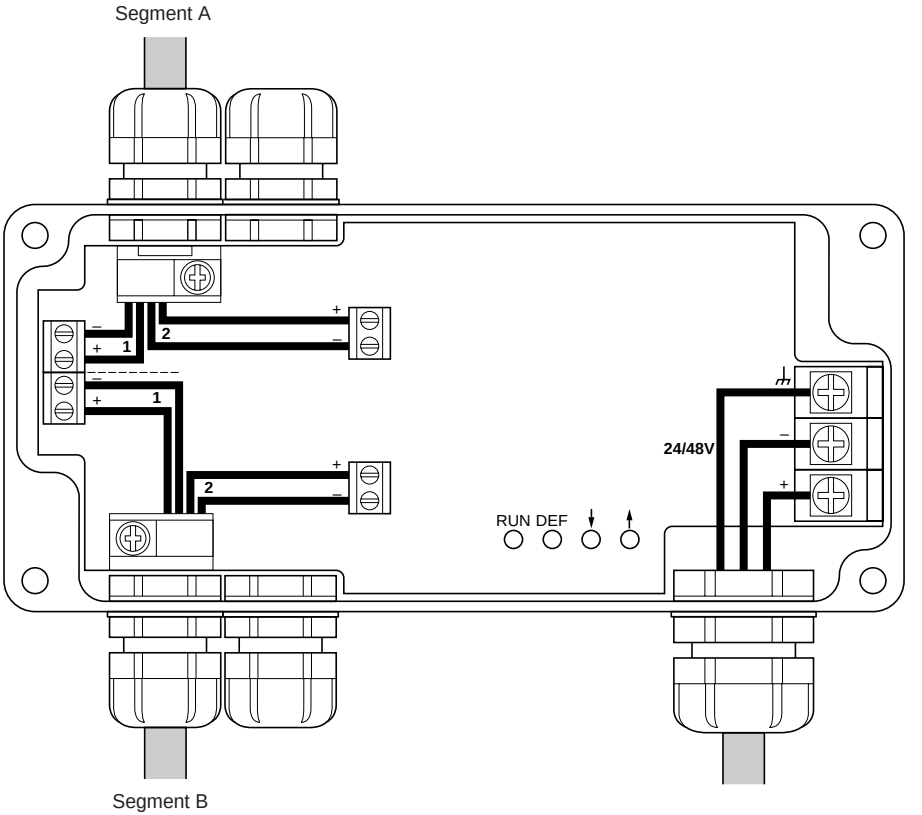
Reminders for FIPWAY / FIPIO segments :

(+) corresponds to the red or orange wire,

(-) corresponds to the green or black wire.

Drop connection

For the repeater, this type of connection is made on FIPWAY/FIPIO segments A and B by means of TSX FP ACC4 connection boxes. If two TSX FP CA/CR xxx cables are used for one of the drops, the Red and Green wires are replaced by the Red and Green wires of the first drop cable, and the Orange and Black wires by the Red and Green wires of the second drop cable respectively.



Reminders for FIPWAY / FIPIO segments :

(+) corresponds to the red or orange wire,

(-) corresponds to the green or black wire.

Extension and drop connection

The FIPWAY/FIPIO structure allows one segment to be connected by extension and the second one by a drop connection. In this case, the repeater will be installed using a drop connection in the two examples illustrated above.

3.5-6 Connecting the TSX FP ACC8 Repeater

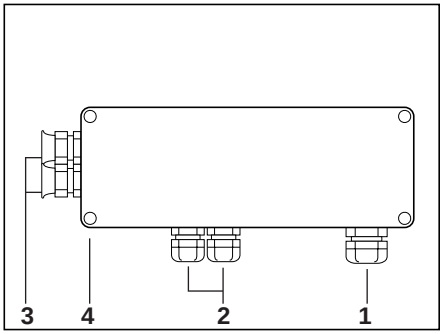
The IP65 sealtight module has 5 cable glands for connection of :

1 power supply,

2 electrical segments,

3 optical fibers,

4 a screw fitted to the exterior which connects the box to the protective ground.



Installing the optical cable

When installing the optical cable, it is necessary to **respect the environmental conditions** specified by the manufacturer and respect the **mechanical stress thresholds** for bending and traction.

It is advisable to **measure the optical attenuation** of the cables **before and after installation** and to check that these stay within the limits specified by the manufacturer.

The mechanical and optical limits of the TSX FP JF 020 cable (jumper cable) are as follows :

- **Bending radius** : always greater than 5 cm,
- **Tensile force** : always below 100 Newtons (10 kg),
- **Attenuation** : always below 1 dB at 850 nm.

Great care must be taken when installing the ST connectors (from the optical or jumper cable) on a TSX FP ACC8 repeater, that the cable is not damaged in any way and that no dust particles are found on the cable which could reduce the quality of the connection. Both jumper cable connectors are identified by a coupling sleeve (one light and one dark) which enables the appropriate base unit to be selected, which in turn is identified by the light or dark label on the board.

To mount the 2 connectors onto the repeater, proceed as follows :

1 Unscrew the 4 fixing screws from the cover and remove it.

2 Remove the plastic protection from the first base unit (marked Tx). Dismantle the outside part of the metal cable gland, and then remove the cut metallic washer and the split plastic seal which is located inside the washer. Remove the small plastic disk from the split seal.

3 Attach the external part of the cable gland, which has just been removed (start with the tapered part), to the optical cable connector which is fitted with a dark sleeve. Then feed this connector through the fixed part of the cable gland.

4 Remove the outer protection of the connector and then attach it to the appropriate base unit (marked Tx). When doing this, check that the connector pin is aligned with the slot under the base unit and by holding the connector (not the coupling sleeve) between thumb and index finger push it towards the base unit and turn it 90 ° to lock it.

5 Place the split plastic seal around the optical fibre, with the tapered side facing the repeater, and push it into the fixed section of the cable gland. Proceed in the same way with the cut metallic washer, then screw the outer part of the cable gland onto the fixed section. Tighten with a torque of 3 Nm, so that the module is sealtight when closed, taking care that the value is not exceeded so as not to damage the optical fiber.

6 Connect the second optical fibre in the same way : the connector is fitted with a clear coupling sleeve on the Rx base unit.

Note

The optical cable connecting 2 repeaters can be all in one piece, or made up of a maximum of 5 sections, which are equipped with ST type connectors (or of at least equivalent quality). **It is therefore possible to have a maximum of 4 intermediate connections**.

D

Installing electrical cables

The various cables are connected in the same way as for the TSX FP ACC6 repeater, by using screw terminal blocks, following the method described in the FIPWAY/FIPIO reference manual : extension or drop connection, taking into account the access to cables 1 and 2, the + and - polarities of the wires and the possible addition of a TSX FP ACC7 line terminator when the repeater is at the end of the electrical segment.

The supply cable can consist of two or three 2.5 mm^2 conductors and its diameter must be between 8 and 13 mm.

Setting-up procedure

The TSX FP ACC8 repeater is ready to operate as soon as it is powered up. However, a circuit-breaker which is placed on the electronic board must be set according to how the repeater is used :

- for an optical connection to another TSX FP ACC8 repeater, the circuit breaker must be in position R (**R**epeater),
- for an optical connection to a FIP optical station, the circuit breaker must be in position **S** (Station).

3.5-7 Connecting TBX BLP 01 Connectors

The various cables are connected by means of a screw terminal block. The procedure is as follows :

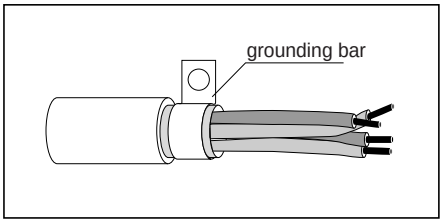
1 Open the connector,

2 Prepare the cables as described on the previous pages and then screw each wire into the screw terminal block, observing wire pairing and polarity : Red (+) / Green (-) and Orange (+) / Black (-). The wiring diagrams below show the different types of connection possible, i.e. extension or drop connection,

3 Secure the grounding clamp(s) into the connector, taking care not to pinch the wires,

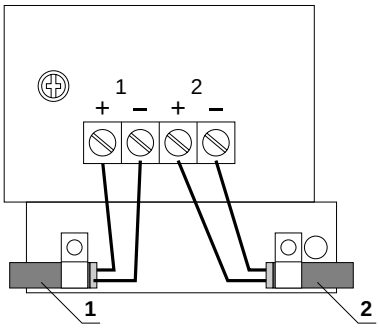
4 Remove the blanking caps on the cover to expose the cable feed-throughs,

5 Refit the cover and tighten.



Extension connection

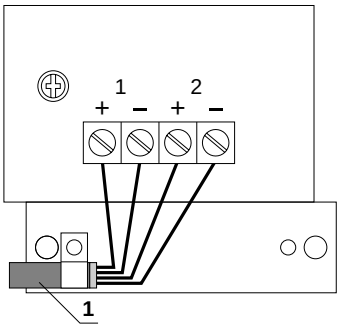
If the device is placed at the start or the end of a FIPWAY/FIPIO segment, only cable **1** is connected to the connection box. In this case, cable **2** must be replaced by an unpolarized TSX FP ACC7 line terminator.



The direction from which the cables arrive is of no importance. They can be installed opposite each other (as shown in the example) or on the same side etc.

Drop connection

In the diagram cable **1** is a TSX FP CCxxx drop cable. If the drop is achieved by 2 TSX FP CA/CRxxx cables, connect in the same way as for extension connection.



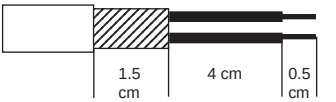
The direction from which the cable arrives is equally of no importance.

3.5-8 Connecting TBX BLP 10 Connectors

The various cables are connected by means of a screw terminal block. The procedure is as follows :

1 Open the connector, remove the board and feed the cables through the cable glands,

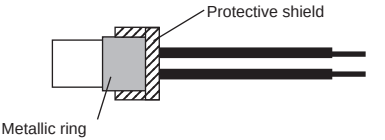
2 Prepare the cables as shown opposite and then screw each wire into the screw terminal block, observing wire pairing and polarity :
Red (D+) / Green (D-) or Orange (D+)/ Black (D-) and Pink (+) / Blue (-).



3 **Set the address using the switches.**

4 Preform the conductors to ease installation of the board.
Remove the cable glands and locate the board in its correct position.

5 Place the screen covers on the metal rings (the aluminium foil cover is cut as short as possible) and retighten the cable glands **(tightening torque of 3 Nm)**.



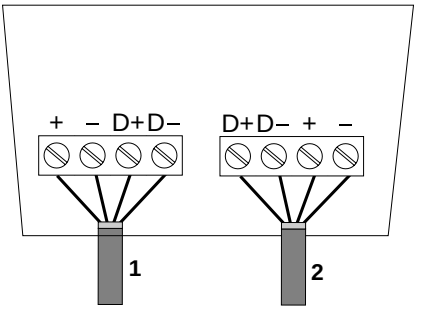
6 Secure the board.

The wiring diagrams below illustrate the various types of connection possible : **extension or drop connection.**

Extension connection

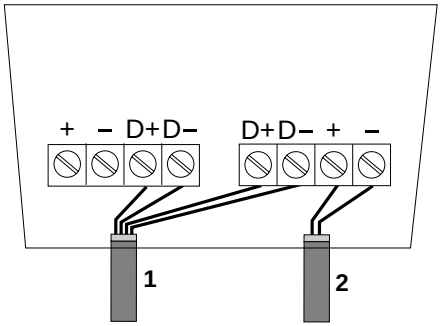
Cable **1** or **2** is a TSX FP CA/CRxxx drop connection and power supply cable.
If the device fitted with a connector is at the beginning or at the end of the FIPWAY segment only cable **1** is connected to the connection box. In this case, cable **2** must be replaced by a TSX FP ACC7 line terminator (unpolarized), which is connected to D + and D -.

The insertion direction is not important.

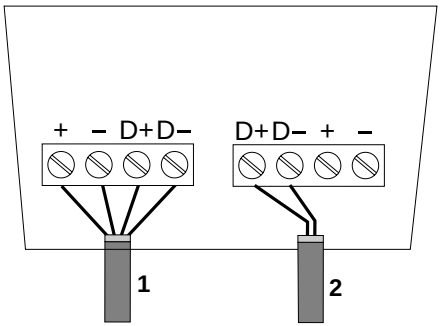


Drop connection

Cable **1** is a TSX FP CCxxx type drop cable. Cable 2 is a straight forward power supply cable.



Cable **1** is a TBX FP CFxxx type drop cable, cable **2** is a TSX FP CA/CRxxx type cable.



D

4.1 General

In order to avoid wiring errors and ensure that the network will operate correctly, it is recommended that certain checks be carried out during the installation of each segment :

- Check the electrical continuity of the segment as the wiring accessories are connected : connectors, taps, repeaters,
- Check that the line terminators are fitted properly i.e. bus matching before connecting the devices,
- Check that the devices are properly connected to the bus before they are powered up.
- If TSX FP ACC6 repeaters are used, the above checks must be carried out individually on each segment. These repeaters must not be powered during these tests.

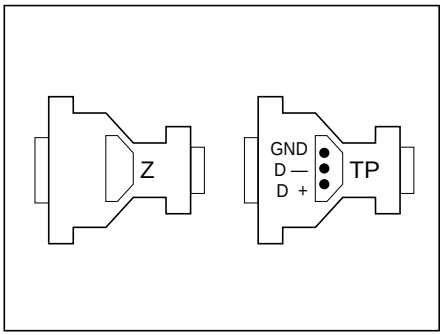
Material required

The test procedures described below require an ohmmeter and the TSX FP ACC9 wiring test tool. This tool comprises two modules :

- A Z module which is to be connected to the first connection accessory,
- A TP module containing the three test points needed for take measurements.

Each of these modules is equipped with two connectors (a SUB-D 9-point male connector and a SUB-D 26-point high density female connector) that can be connected to the FIPWAY/FIPIO wiring system.

- TSX FP ACC9 marked Z
- TSX FP ACC9 marked TP

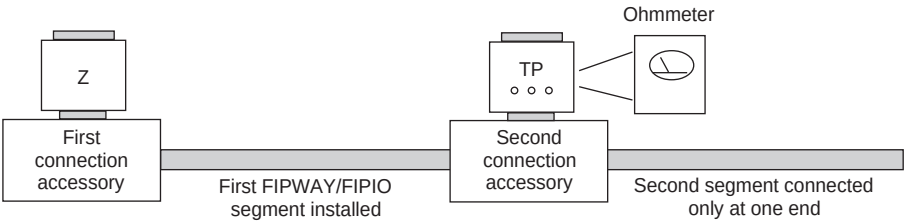


Any faults detected during these tests must be remedied before proceeding with the rest of the installation. The checks required during each installation phase are only to be performed if the results of the previous tests are satisfactory.

4.2 Checking Bus Continuity

Procedure :

- Wire the first connection accessory (including the shielding) and connect the Z module to it.
- Wire the second connection accessory and connect the TP module to it.



- Using the Ohmmeter, measure resistance rl across the GND and D- terminals of the TP module.

  Check that rl is 500 to 600 Ohms.

  If rl < 500 Ohms, there is a short circuit between one of the wires (D+ or D-) and ground.
  If rl > 600 Ohms, the shielding or the D- connector is incorrectly connected.

- Using the Ohmmeter, measure the resistance RH across the GND and D+ terminals of the TP module.

  Check that RH > rl.

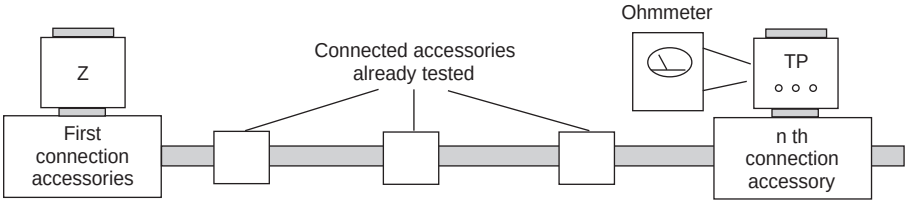
  If RH = rl, there is a short circuit across D+ and D-
  If RH < rl, the D+ and D- wires are inverted

- Calculate the difference RH - rl.

  Check that this result is 30 to 60 Ohms. If this is not the case, there is a poor contact on one of the wires.

  Do not measure the resistance between D+ and D- directly as this measurement will not detect wire inversion.

- If there are several cable segments still to be connected,
  - disconnect the TP module,
  - wire the cable segment and the next connection accessory and then connect the TP module to them,



  - repeat each measurement using the procedure described above.

Checking bus continuity when a TSX FP ACC6 repeater is used

The connection of each TSX FP ACC6 repeater is checked before its cover is fitted. This operation is carried out in two steps :

- When the segment connected to channel A is wired, by following the procedure described earlier. The measurements are taken with the ohmmeter directly on one of the screw terminal blocks of channel A (the Z module should be connected to segment A),
- When the segment connected to channel B is wired, by following the procedure described earlier. The measurements are taken with the ohmmeter directly on one of the screw terminal blocks of channel B (the Z module should be connected to segment B).

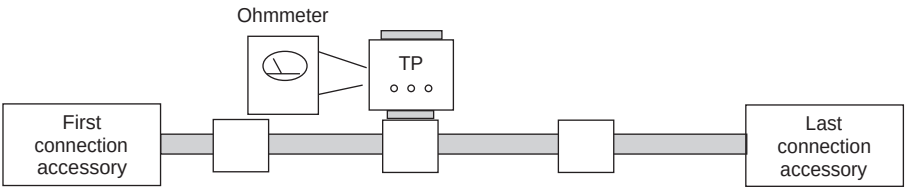
Checking bus continuity when a TSX FP ACC8 repeater is used

The connection to the electric segment of each TSX FP ACC8 repeater is checked before its cover is fitted as described above. The measurements are taken with the ohmmeter directly on one of the two small TBX FP ACC8 screw terminal blocks.

4.3 Testing for Line Terminators

Procedure :

- A TSX FP ACC7 line terminator must be systematically placed at the beginning and end of an electrical segment. This terminator is connected to the bus via the connection accessory fitted to the end of the segment (at the place where the next cable segment would have been connected if planned). The terminator is not polarized and each wire can be screwed into each of the terminals provided for the cable in any order whatsoever. It must be connected to ground by a clamp or a bar.
- Once the electrical continuity of the segment has been tested (same procedure as above), disconnect the Z module but leave the TP module connected to one of the connection accessories.
- All the stations on the segment must be disconnected during this test.
- Using the ohmmeter, measure resistance rI (across the GND and D- terminals of the TP module TP) and resistance RH across the GND and D+ terminals of the TP module).



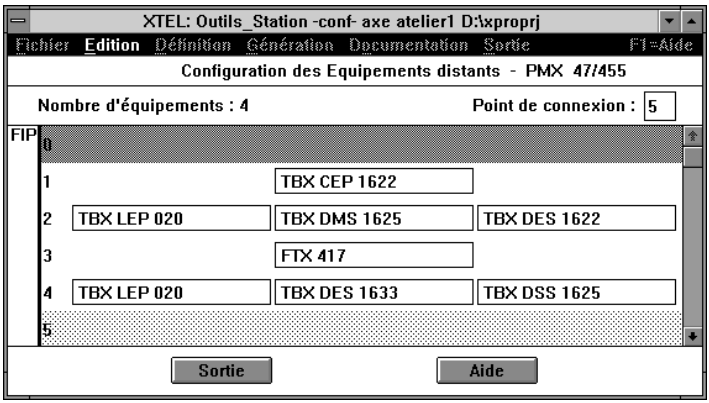
Check that resistances rI and RH are within the 450 to 650 KOhm range.
Values that are twice as high indicate that one of the line terminators has not been connected.
Values lower than 450 KOhms indicate that the Z module has not been connected, a station is still connected, or a short circuit.

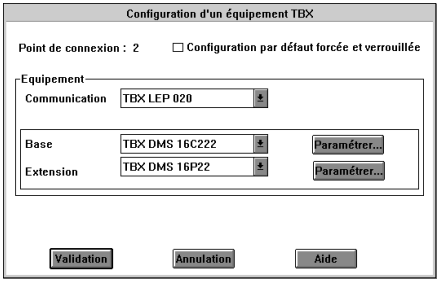
5.1 XTEL-CONF Station Tool

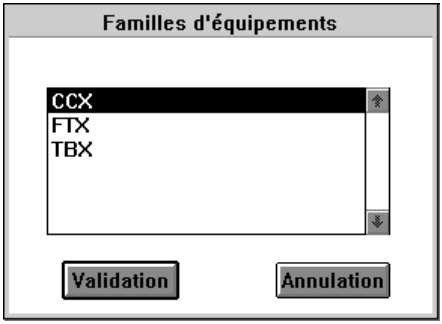
The XTEL-CONF station tool is used to configure rack-mounted equipment and remote devices installed on the FIPIO bus. It runs in an X-TEL environment on FTX 507, FTX 417 or PC-compatible terminals.

To configure FIPIO devices, proceed as follows :

- Select a processor equipped with a FIP link,
- Define a FIPIO configuration, which gives access to the screens used to choose the device family for each connection point : TBX, FTX etc. For modular TBXs this will allow you to choose the type of configuration, i.e.; communication module, basic connection base, extension connection base. Connection points 0 and 63 (reserved for the PLC and the console respectively) are not configured.







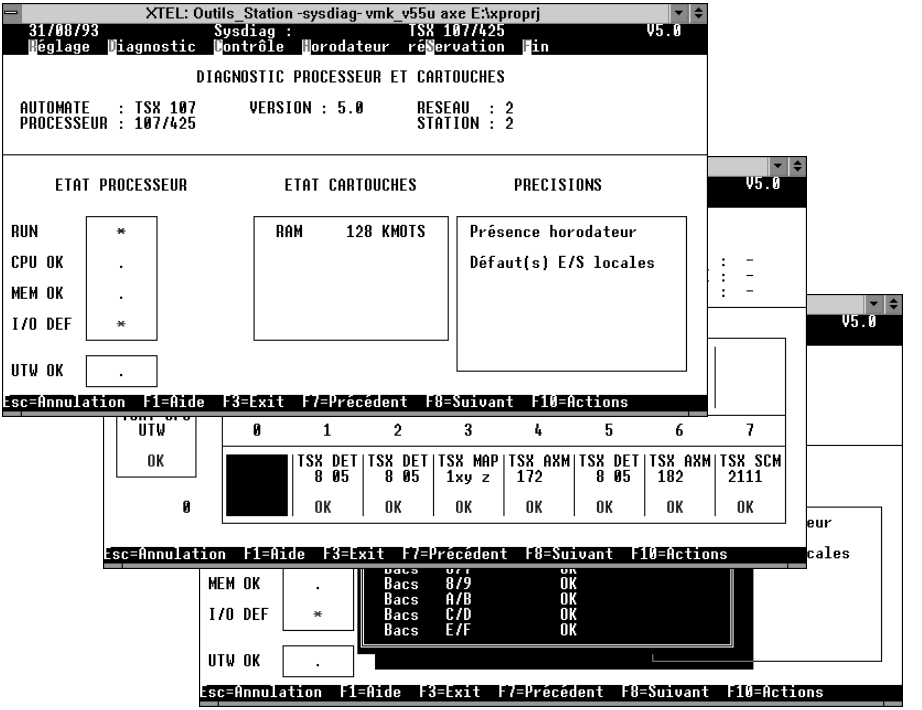
For more information on XTEL-CONF, refer to the XTEL Software Workshop Manual.

5.2 SYSDIAG Station Tool

The SYSDIAG station tool provides diagnostics for the PLCs and their I/O (local or remote) on a FIPIO fieldbus.

SYSDIAG is the basic diagnostics tool for FIPWAY, TELWAY or UNI-TELWAY networks. It identifies the active or faulty stations and provides information on network traffic and transmission errors.

It runs in the X-TEL software workshop on an FTX 507, FTX 417 or PC-compatible terminal (SYSDIAG runs on DOS or OS/2 depending on the version used).



For more information on SYSDIAG, refer to the SYSDIAG, PL7-2 / PL7-3 Adjustment and Diagnostic Software Manual.

5.3 NETDIAG Software

The NETDIAG program provides network diagnostics for the FIPWAY, MAPWAY, ETHWAY and TELWAY networks. It runs in the X-TEL software workshop environment on a programming terminal directly connected to FIPWAY through a dedicated module (TSX FPG10 or TSX FPG20). The main functions of NETDIAG are :

DIAGNOSTICS function

- Complete network architecture diagnostics,
- Network segment diagnostics,
- Station diagnostics,
- Network module diagnostics.

TRACE function

This function stores and displays application messages travelling on the network depending on :

- The source address,
- The target address,
- Function start/stop conditions,

ANALYZER function

This functions helps the user during network installation. Through detailed information display, physical problems can be detected quickly, depending on the start/stop conditions of the function.

PERFORMANCE function

This function provides the user with information for analyzing network performance :

- Network load factor,
- Application rate per station,
- Response time on a communication path.

Using this information, the user can determine the impact of inserting and deleting a station from the network. A simple traffic analysis will detect user and application program errors (programming errors, operation sequencing errors etc.).

For further information, refer to the NETDIAG User's Manual.

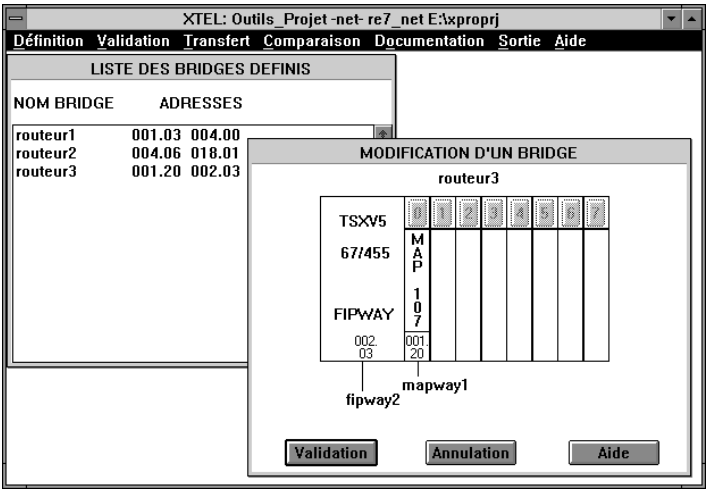
5.4 PL7-NET Software

PL7-NET is used to describe, check the coherence and document TSX series 7 PLC automation systems. PL7-NET runs in the X-TEL software workshop on FTX507s, FTX 417s etc.

This program is absolutely necessary when describing multiple network architectures and is highly recommended when setting up single network architectures.

PL7-NET enables :

- Complete description of the multiple network architecture :
  - network selection (FIPWAY, TELWAY, MAPWAY, ETHWAY, MMS/ETHERNET, etc.) and entry of the name and number assigned to each segment,
  - selection of stations on a segment and station address assignment,
  - interconnection of segments by selecting bridge PLC stations (a bridge ensures the routing of messages between segments),
  - assignment for each bridge of its network modules to the different network segments (except FIPWAY which is in the processor).



This data is used by PL7-NET to generate the routing tables for each bridge on the network,

- Transfer of files generated by PL7-NET to bridge PLCs (with a compare function),
- Network architecture documentation.

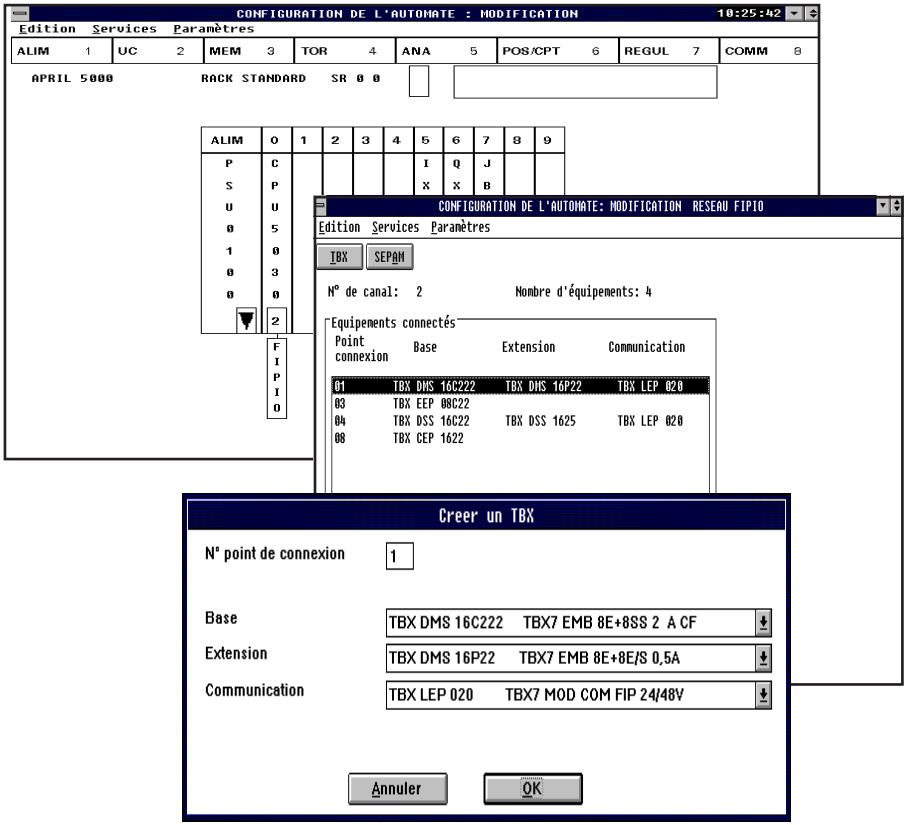
For further information, refer to the PL7-NET User's Manual.

6.1 ORPHEE Configuration

The CONFIGURATION module is used to configure rack-mounted equipment and remote devices via the FIPIO bus. It is accessed in the ORPHEE APPLICATION(S) environment on FTX 507, FTX 417 or PC-compatible terminals connected to the service link.

To configure FIPIO devices, proceed as follows :

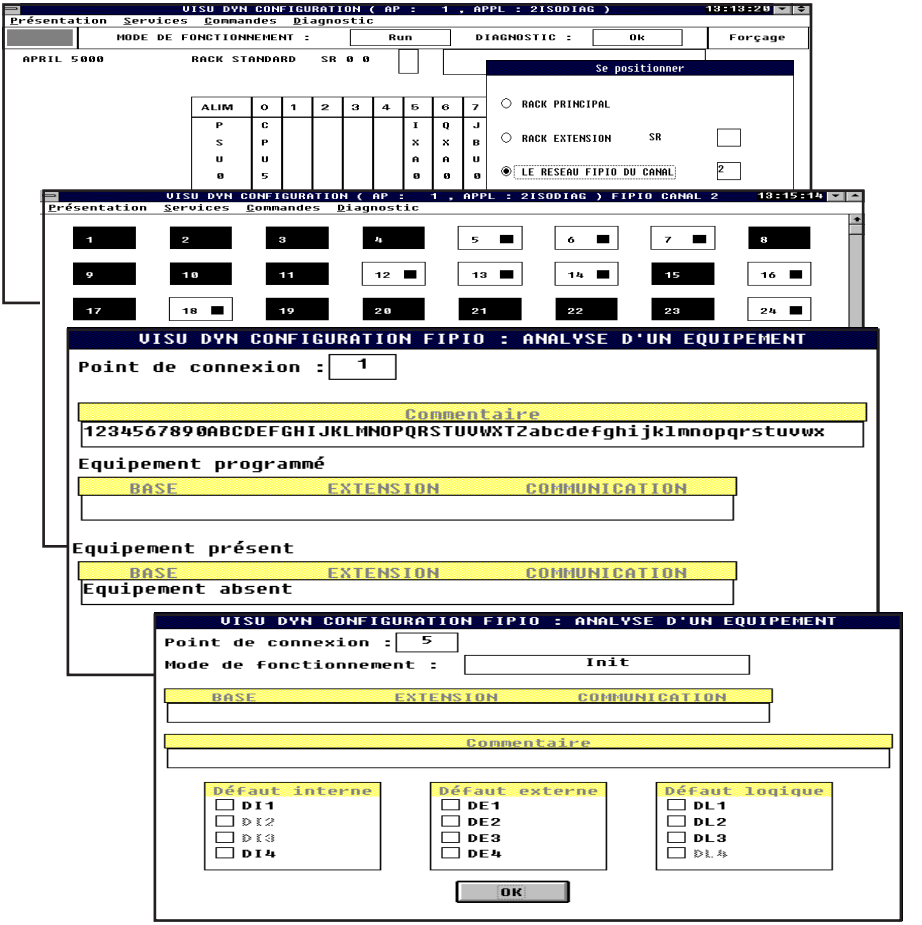
- Select a processor equipped with a FIP link,
- Define a FIPIO configuration, which gives access to the screens used to choose the device family for each connection point : TBX, SEPAM etc. For modular TBXs this enables the user to select the type of configuration for the device : communication module, basic connection base, extension connection base. Possible connection points are between 0 and 62, (connection point 0, which is reserved for the PLC, is not configured).



For more information on the configuration, refer to the ORPHEE manual Ref. TEM10000E.

6.2 ORPHEE or ORPHEE-DIAG Diagnostics

In operating mode, the CONFIGURATION module provides diagnostics for the PLCs and their I/O (local or remote) on a FIPIO fieldbus.
It is accessed in the ORPHEE PLC(s) DIALOGUE or ORPHEE-DIAG environment, on an FTX 507, FTX 417 or PC-compatible terminal which is connected to the service link. It identifies active or faulty elements.



In addition, the display screens for the hardware configuration are used to obtain similar information to that available for rack-mounted boards.

For more information, refer to the section on operation in the ORPHEE manual Ref. TEM10000E or ORPHEE-DIAG manual Ref. TEM10800E.

6.3 SYSDIAG Station Tool (DOS)

The SYSDIAG (DOS) tool available on series 7, has a function which can be used on the APRIL 5000 PLC.
This function provides diagnostics for any possible wiring problems on the FIPIO fieldbus. For additional information, refer to the section on diagnostics in the SYSDIAG, Adjustment Software manual.

Section **Page**

Section **Page**

E

1.1 Operating Principles

1.1-1 General

FIP and the OSI model

FIP standards have been raised against the ISO model of the ISO. This model comprises seven layers, three of which are required for FIP. These are :

7 - application layer,

2 - data link layer,

1 - physical layer.

In addition, the FIP standard includes a complete description of network management.

The user can only access the upper interface of the communication entity (the user interface of the application layer) through "request, indicate, confirm" exchanges corresponding to communication services.

Operating principle

FIP is based on the sending of information. Data exchange is based on the following :

- the network controller called the bus arbiter sends a call to all stations. This call is for a producer subscriber and any interested consumers,
- the producer subscriber sends a reply to all stations which can be used by all the consumer subscribers.

All FIP functions use this type of exchange.

1.1-2 Bus Arbiter

The bus arbiter is a function which broadcasts the different identifiers cyclically according to a preset list.

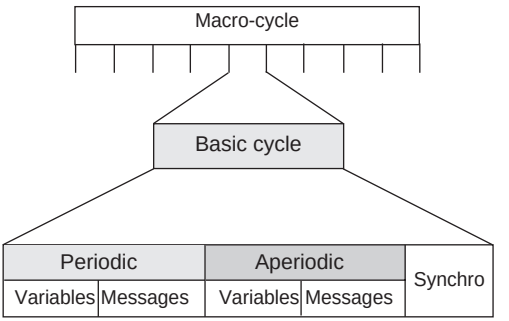
In an application, all of the variables do not have to be updated at the same frequency. This list must be organized in such a way to allow, if required, a variable to be called several times within the same cycle in which all the variables are called (macro-cycle).

Some identifiers can be called several times during the same macro-cycle. This will increase the sampling frequency, taking into account the time restrictions imposed by the application.

The duration of the macro-cycle is set and known. The application can therefore determine the exact instant the consumers will have access to a variable.

Each macro-cycle is divided into basic periods of the same duration and structure. These periods are themselves divided into time windows :

- "Variables" and/or "messages" periodic window,
- "Variables" and "messages" aperiodic window,
- Synchronization window.



1.1-3 Periodic Window

The periodic window corresponds to the basic operation of the network. It is based on the following principle :

- Each process variable (integer, real, boolean, character set, etc.) is associated with a cyclical identifier,
- Each cyclical identifier is called at least once during a macro-cycle.

When an identifier is sent, the station which must produce the associated variable replies with its value. All basic transactions or transfers are based on the exchange of two successive frames : the bus arbiter (arbiter initiative) sends the name of the variable (identifier) and the producer replies with the value of the variable. The variable is then consumed by each of the stations concerned. All the stations can participate in the transaction.

1.1-4 Aperiodic Window

This window is an extension of the periodic window. It allows the producer to request the following :

- Special interrogation of one or more variables ("variables" aperiodic window),
- Message transmission ("messages" aperiodic window).

These requests are made by the producer or the consumer in the cyclic period when replying to a request it has received.

They are recorded by the bus arbiter which executes them in accordance with availability in the variable and message aperiodic windows. These windows are located in the same basic period or in the next periods depending on the workload of the network.

Variables aperiodic window

The bus arbiter interrogates the waiting initiator so that it will specify the list of variable identifiers it wants to be sent.

The response is acknowledged by the bus arbiter which adds the requested identifiers to the normal list of the current period or the next period. This acknowledgment is executed with reference to the time available before the end of the basic period.

When there are several requests the bus arbiter sorts them, allowing for priority and order of arrival.

The initiator can be a producer or a consumer of the requested variables or have no relationship at all with the variables.

Aperiodic "Messages" Window

The bus arbiter hands over" to the waiting initiator in the selected time window. The initiator sends its message preceded by the target address and the source address. Once the transaction has been completed, it sends an "end-of-transaction" message to the bus arbiter so the latter can process the next initiator (if the new request is compatible with the width of the time window).

The following types of message are possible :

- Messages with/without acknowledgment (ACK),
- Negative acknowledgment messages (NACK) in broadcast mode.

The protocol sets the characteristics of a message envelope and proposes a structure and language that will enable the target to understand the message without requiring any type of initiation.

1.1-5 Synchronization Window

It ensures a constant duration of the basic periods by filling in the dead times (packing)).

1.1-6 Network Management

The above information is for a network operating in a steady state. FIP handles the different phases for achieving this state, i.e :

- Configuration : inserts variables, identifiers, parameters into the system etc.
- Implementation : performance tests, detects adding and deletion of subscribers, modifies global communication parameters, identifies subscribers etc.,
- Detects and processes faults (traffic monitoring etc.).

All the corresponding functions are divided among the communication entities of the network subscribers, including the bus arbiter.

1.2 Communication Access

1.2-1 Electing the Bus Arbiter

FIP cannot operate without an active bus arbiter on the network. Depending on the type of network (FIPWAY or FIPIO), the bus arbiter is elected differently.

FIPWAY network (series 7 PLCs only)

All stations connected to FIPWAY are a potential bus arbiter. When powered up, each potential bus arbiter triggers the election of the active bus arbiter.

The election procedure is based on the lapse of a time-out, the initial value of which depends on the physical address of the station and the priority of this station to act as bus arbiter. The count-down of this time-out is started as soon as inactivity is detected on the network. The station which reaches zero first takes control of the network and becomes the active bus arbiter.

If power up is simultaneous, the following station is elected active bus arbiter :

- Firstly, the high priority station (model 40 PLCs, followed by TSX 17-20s and PC terminals),
- Secondly, the station with the lowest physical address within a group of stations having the same priority,
- Starting up a model 40 PLC on the network comprising only TSX-17 micro-PLCs will retrigger the election of the bus arbiter.

FIPIO bus

On a FIPIO fieldbus, the bus arbiter is always the PLC whose address is 0.

1.2-2 Detecting the Presence of a Station

All stations that are part of the network respond cyclically when the presence variable they produce is scanned. The presence of the station on the network is indicated in this way.

As soon as it is elected, the bus arbiter checks the presence of all the 64 stations that can be connected, and sends the host application the list of stations responding or not responding to their presence variable.

A station that has been recently connected to an operating network with a physical address that is identical to a connected station cannot join the network or the bus.

1.2-3 Exchanging COM Words

COM words are exchanged on FIPWAY as cyclic identified variables, the associated period of which is 40 ms.

A station with physical address NN (between 0 and 31) produces 4 COM words in response to an identifier frame and the corresponding FIPWAY application variable comprises a data code byte, a data length byte, eight COM word bytes and a status transmission byte.

All the other stations with addresses 0 to 31 consume this COM variable.

1.2-4 Exchanging Telegrams

Telegrams are exchanged on FIPWAY as cyclic messages, the associated period of which is 10 ms.

A station with physical address NN (0 to 15) responds to an identifier frame and any application message transmitted will be a series 7 datagram. The maximum size of the data area is 16 bytes.

The target station recognizes itself in the target address coded over three bytes before the actual telegram.

1.2-5 Exchanging Series 7 Datagrams

Series 7 datagrams are exchanged on FIPWAY/FIPIO as aperiodic messages.

The pass-band of the aperiodic messages which is shared by all the stations is :

- 210 messages of 128 application bytes per second for FIPWAY
- 20 messages of 128 application bytes for FIPIO.

The application message sent is a series 7 datagram. The maximum size of the data area is 16 bytes.

A station can initiate a maximum of 37 exchanges per second on FIPWAY.

1.2-6 Reading and Writing the Remote I/O

I/O are exchanged on FIPIO as cyclical variables.

The scan period depends on the number, type and the task in which each TBX module is declared. It is calculated when the I/O configuration is generated (using Environment Configuration in the X-TEL or ORPHEE software workshops) and then sent to the PLC processor when the program is transferred.

The algorithm used for series 7 ensures that each I/O is refreshed in a time that is less than the period of the task in which it is configured.

For series 1000, the I/O are tabulated within each elementary cycle. The tabulation frequency for each I/O depends therefore only on the programmed configuration and is independent from the CPU cycle time.

1.3 Selected Parameters

1.3-1 FIPWAY Parameters

Physical layer

- CH conformance class,
- S2 speed,
- No remote power supply,
- Grounding : equipotential grounding network.

1.3-2 FIPIO Parameters

Physical layer

- CH conformance class,
- S2 speed,
- No remote power supply,
- Grounding : equipotential grounding network.

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1.3-3 TSX FP ACC8 Optical Repeater Parameters

Physical layer

- cs_62,5+ conformance class,
- S2 speed,
- No remote power supply,
- Grounding : equipotential grounding network.

1.4 Cable Characteristics

1.4-1 TSX FP CA xxx Trunk Cable

Main Characteristics

- Diameter = 7.8 mm ± 0.2 mm with two 22-gauge wires,
- Diameter on metal braid = 6.4 mm ± 0.2 mm,
- Composed of one twisted pair matched to 140 Ω < Zc < 155 Ω,
- Attenuation at 1 MHz ≤ 12 dB/Km,
- Linear resistance at 20°C ≤ 52 Ω/Km (static),
- Metal braid and inner insulation shielding,
- Minimum bending radius = 75 mm,
- Can be used in the factory for voltages less than 36 V,
- Storage temperature : -25°C to + 70°C,
- Operating temperature = +5°C to + 60°C,
- Flame tests to UL VW-1 standard,
- Applicable test standards : IEC 189-1 and IEC 885-1,
- Complies to French standard NFC 46-604,
- Use inside a static installation. Usage criteria see section 3.1-1.

1.4-2 TSX FP CR xxx Flexible Trunk Cable

Main Characteristics

- Diameter = 8.6 mm max, with two AWG 24 gauge wires,
- One twisted pair matched to : 150 Ω ± 15% (3 to 20 MHz),
- Dynamic bending radius : 65 mm,
- Metal braid and inner insulation shielding,
- Storage temperature : -40°C to + 70°C,
- Operating temperature = -5°C to + 70°C,
- Vertical flame test,
- Non propagation of flames,
- Applicable test standards : IEC 885-1,
- Complies with standard NFC 46-604,
- Resistance to oils,
- Resistance to hydrocarbons,
- Resistance to sparks from welding,
- Resistance to ultraviolet light,
- Resistance to saline atmospheres,
- Resistance to relative humidity of 100%,
- Usage criteria see section 3.1-1

1.4-3 TSX FP CF xxx Flexible Remote Power Cable

Main characteristics

- Diameter = 9.5 mm ± 0.3 using two AWG 22 gauge conductors (FIPIO), and two AWG 18 gauge conductors (power supply),
- Composed of one twisted pair matched to 140 Ω < Zc < 155 Ω,
- Attenuation at 1 MHz ≤ 12 dB/Km,
- Linear resistance at 20°C ≤ 52 Ω/Km (static),
- Metal braid and inner insulation shielding,
- Minimum bending radius :
  static = 10 times the diameter,
  dynamic = 20 times the diameter.
- Can be used in the factory for voltages less than 36 V
- Storage temperature: -25°C to + 70°C,
- Operating temperature: -10°C to + 70°C,
- Flame test : standard UL VW-1,
- Non propagation of flames : NFC 32-70 - C2,
- Applicable test standards: IEC 885-1,
- Conforming to standards NFC 46-604,
- Resistance to oils,
- Resistance to hydrocarbons,
- Resistance to sparks from welding, NFC 32-510,
- Resistance to ultra-violet light,
- Resistance to saline atmospheres,
- Resistance to relative humidity of 100%,
- Usage criteria: see section 3.1-1.

E

1.4-4 TSX FP CC xxx Drop Cables

Main Characteristics

- Diameter = 7.8 mm ± 0.2 mm with four 26-gauge wires,
- Diameter on metal braid = 6.4 mm ± 0.2 mm,
- Composed of two twisted pairs matched to 140 Ω < Zc < 155 Ω,
- Attenuation at 1 MHz ≤ 17 dB/Km,
- Linear resistance at 20°C ≤ 135 Ω/Km (static),
- Metal braid and inner insulation shielding,
- Minimum bending radius = 75 mm,
- Can be used in the factory for voltages less than 36 V,
- Storage temperature : -25°C to + 70°C,
- Operating temperature = +5°C to + 60°C,
- Flame tests to UL VW-1 standard,
- Applicable test standards : IEC 189-1 and IEC 885-1,
- Complies to French standard NFC 46-604,
- Use inside a static installation. Usage criteria see section 3.1-1.

Acknowledgment

Response frame indicating that a data frame has been received correctly. FIP protocol only manages the acknowledgment notion at link level.

Bridge

A device that interconnects two network segments or two networks in a transparent manner at data link layer level. Addressing continuity is ensured between two segments both before and after the bridge.

Bus arbitrator

A FIP element which controls the access rights to the medium of each information producer. There must only be one active bus arbiter in FIP at a given moment.

COM Words

A specific AEG Schneider Automation service (common words) that enables reading and writing of a database common to all stations on a network. The data is stored as a list of words shared between all stations.

Control field

In a transmitted frame, the part that specifies the type of information exchanged and the type of exchange.

Cyclic scan of variables

A function carried out by the bus arbiter consisting of cyclic exchange of variables, which is the basic principle of FIP.

Datagram

A structured data packet that transits through the network. Each data packet is a separate entity on the network.

Driver

A program included in the operating system that executes transmission/reception requests via a specified peripheral. A driver is dedicated to a peripheral. It will not interpret messages read or written.

Drop cable

The cable connecting a station to a tap.

Flow (Data-rate)

The transmission capacity of the medium expressed in bits/second (b/s).

Frame

A group of bytes sent over the network containing data or control information.

Gateway

A station that interconnects two types of any network together. It acts as an interface at application layer level. A gateway performs address and/or protocol conversions enabling communication between devices on different networks.

Identified consumed variable

Local notion for a FIP entity. It indicates that the variable corresponds to an identifier on which the entity will receive a data item.

Identified produced variable

Local notion for a FIP entity. It indicates that the variable corresponds to an identifier from which the entity will transmit a data item.

Identified variable

FIP variable with an associated identifier.

Identifier

A 16-bit word associated with a variable for the unique characterization of this variable in a FIP system.

Identifier frame

Data sent by the bus arbiter to assign the medium to each information producer.

ISO

International Standards Organization.

Layer

A layer is a set of services that perform a function as defined by the ISO in their ISO model for distributed systems. A layer provides an access interface and uses the interface provided by the layer below it.

- Layer 1: Physical,
- Layer 2: Data Link Layer,
- Layer 3: Network,
- Layer 4: Transport,
- Layer 5: Session,
- Layer 6: Presentation,
- Layer 7: Application,

Line terminator

A component that is connected to the extreme ends of a segment to ensure that a matching impedance is maintained.

Management information base

A set of data to be managed in a network. Some of the information contained in this base concern a particular layer but the exchange protocol and format are always at application layer level.

Medium

Usually refers to the complete wiring system : cables, connectors, taps, etc..

Multiple network

A network architecture comprising several segments connected by bridges (series 7 PLCs only).

Protocol

A set of rules required to ensure that various elements, often remote, can establish and maintain data exchanges.

Response frame

Data sent by the information producer as a response to an identifier frame. This data is sent to all consumers.

Scan table

A table containing all the identifiers. Scanning these variables constitutes the FIP macro-cycle.

Series 7

A specific AEG Schneider Automation application service that receives and transmits datagrams on the network (text function blocks, UNI-TE requests, programming requests, debugging, adjustments etc.).

Slot time

The maximum time that a station that has finished sending must wait to detect transmission by the next station.

Station (Device)

A device connected to a segment. A station can exchange data with other stations. It has a unique address on the entire network.

Tap

A device for connecting one or more stations to the network via the trunk cable.

Triggered scan of messages

A function carried out by the bus arbiter enabling aperiodic message transfers.

Triggered scan of variables

A function carried out by the bus arbiter enabling aperiodic variable transfers.

Trunk cable

The cable that connects the stations together in extension mode.

UNI-TE

The AEG Schneider Automation proprietary message handling service that provides a single communication interface for all AEG Schneider Automation components and those from other vendors that support UNI-TE. It comprises a list of standard requests based on a Client/Server concept providing the following services :

- Access to variables,
- Control of operating modes,
- Network and device management,
- Up/downloading of files and programs.

The implementation of a FIPWAY or FIPIO application may require a knowledge of the following manuals :

- Wiring Guide Manual, TSX DG GND E for rules and installation precautions for wiring a network.

Series 7 :

- Model 40 Processor Manual, TSX DM PR 40E for FIP functions built into the processor,
- TBX Remote Input / Output Module Manual, TSX DM TBX T V52E for installing TBXs with series 7 PLCs,
- TSX FPC 10/20 FIP Network Module Manual, TSX DM FPC 10M for installing :
  - the FIP module on FTX 507 and CCX 7 programming terminals and on PC terminals,
  - the FIP module on FTX 417-20 programming terminals,
- PL7-3 Languages - V5 Operating Modes Manual, TSX DM PL7 3 V52E, for configuring common words (COM) on model 40 PLCs,
- PL7-2 Languages - V5/ X-TEL Operating Modes Manual, TSX DM PL7 2 V5E, for configuring common words (COM) on TSX 17-20 micro-PLCs,
- PL7-NET Software Manual, TXT DM PL7-NET V5E, for implementing automation system layouts,
- X-TEL Software Workshop Manual, TXT DM V5F XTEL V52E for information on the use of the XREL-CONF tool (configuration of rack-mounted equipment),
- SYSDIAG Adjustment and Diagnostic Software Manual for PL7-2 / PL7-3 Applications, TXT DM SYS V5E for diagnostics of PLCs and their inputs / outputs,
- NETDIAG Network Diagnostics Program Manual, TXT DM NTD V5E for network diagnostics,
- FIPWAY, TSX FPG 10 Module Manual, TSX DM FPG 10 V5E for installing the FIPWAY module on TSX 17-20 micro-PLCs,

Series 1000 (FIPIO only) :

- APRIL 5000 PLC Manual, TEM30000E for FIP functions built into the processor,
- TBX Remote I/O Module Manual, TEM30400E for installing TBXs with series 1000 PLCs,
- ORPHEE V6.1 Software Workshop Manual, TEM10000E for configuration, operation and diagnostics of the APRIL 5000 PLC,
- ORPHEE-DIAG V2.1 Software Manual, TEM10800E for operation and diagnostics on the APRIL 5000 PLC,
- SYSDIAG, Adjustment and Diagnostic Software Manual, TXT DM SYS V5E for diagnostics of PLCs and their I/O.

4.1 Architecture with TSX FP ACC6/ACC8 Repeaters

TSX FP ACC6/ACC8 Description : see section 1.3 part D.

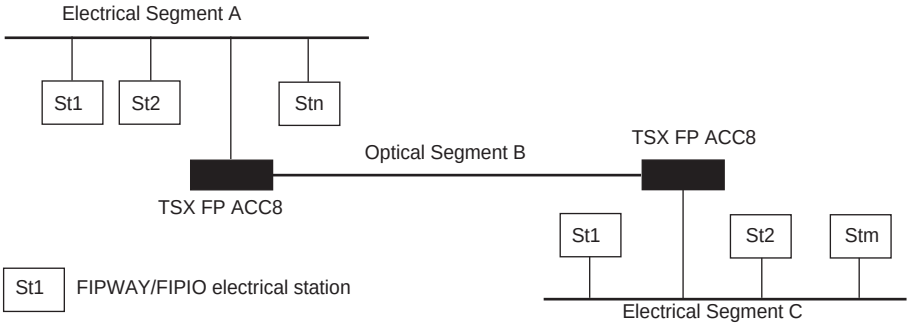
TSX FP ACC6 Connection : see section 3.5-5 part D.

TSX FP ACC8 Connection : see section 3.5-6 part D.

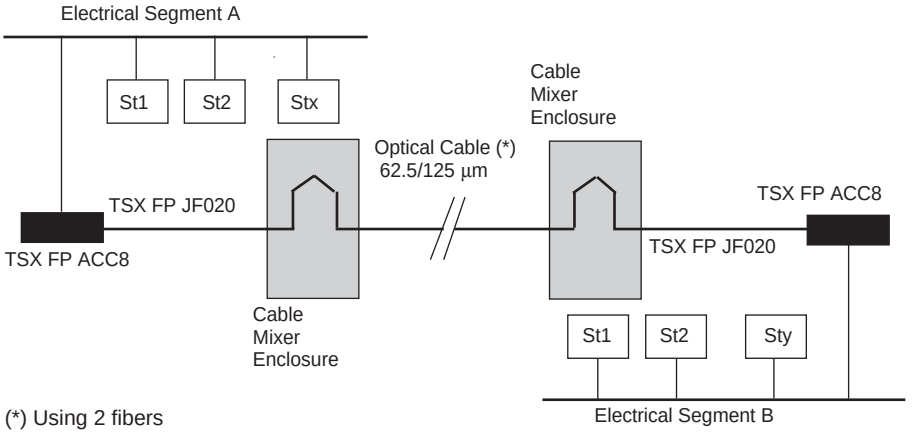
4.1-1 Repeaters between FIPWAY/FIPIO Electrical Segments

Using two TSX FP ACC8 repeaters and an optical segment (two fiber optic cables) will extend the length of the FIPWAY/FIPIO network and increase the number of physical connection points (a maximum of 64 connection points can be logically controlled).

Each electrical segment comprising a shielded twisted pair, with a characteristic impedance of 150 Ohms (TSX FP CA/CFxxx or TSX FP CCxxx cable) is limited to a length of 1000 meters (the equivalent of a "trunk cable") and is fitted with a TSX FP ACC7 line terminator at each end. For more information, refer to the FIPWAY/FIPIO Reference Manual.



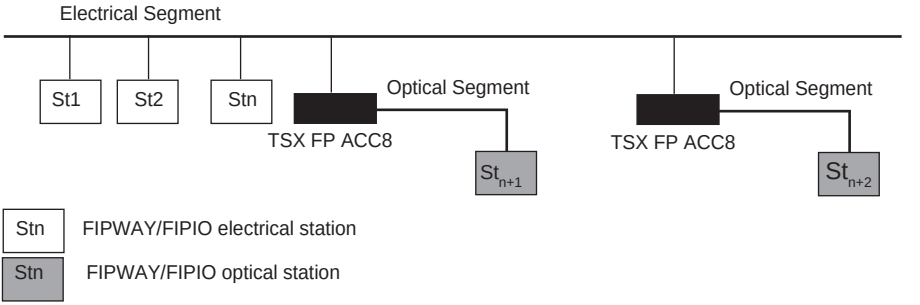
4.1-2 Repeaters Between FIPWAY/FIPIO Electrical Segments with Optical Mixer Enclosure



(*) Using 2 fibers

4.1-3 TSX FP ACC8 Repeaters Interfacing an Optical Station with an Electrical Segment

The TSX FP ACC8 repeater can be used to interface a FIP optical station with an electrical network segment or to set-up a regenerating optical star with n access points (from n "optical/electrical" repeaters), or even for a "fully optical" FIPWAY/FIPIO network (using only optical stations).



4.2 Network Topology

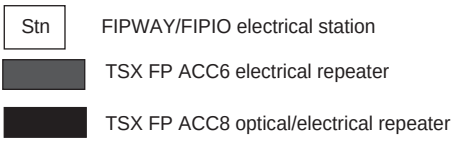
Using "optical/electrical" and/or "electrical/electrical" repeaters enables the following network topoogies to be set up :

- **linear**, to increase the total network length (up to a maximum of 5 kilometers) and/or the number of connection points (up to a maximum of 64 logical connections),
- **tree** or **star**, to cover large areas (measured in tens of acres) and to increase the number of connection points (up to a maximum of 64 logical connections),
- **mixed**, for a compromise between the total network length and the area covered. The number of connection points is also increased (up to a maximum of 64 logical connections).

4.2-1 Topology Guidelines

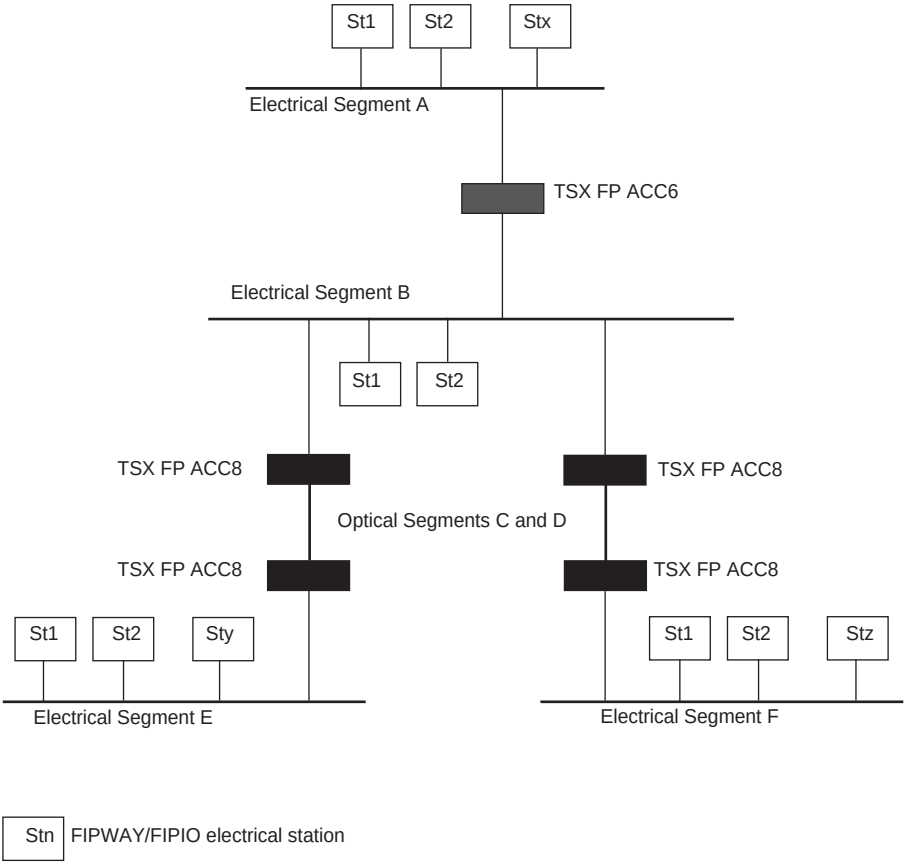
- A segment is restricted to 32 stations, a FIPIO/FIPWAY architecture to 64 stations,
- Each station pair must not cross more than 4 TSX FP ACC6/ACC8 repeaters,
- A TSX FP ACC8 optical/electrical repeater can be located at any point on an electrical segment,
- TSX FP ACC8 optical/electrical repeaters can co-exist in the same network architecture with TSX FP ACC6 electrical/electrical repeaters,
- It is possible to connect up to 32 stations and 4 repeaters (TSX FP ACC6/ACC8) per electrical segment. However, the number of repeaters can be increased to a total of 32, as long as the number of stations on the segment is reduced by the same amount. E.g., 28 stations, 4 TSX FP ACC6 repeaters and 4 TSX FP ACC8 repeaters.

Key to examples 1, 2, 3 and 4 :



4.2-2 Example 1 : star layout

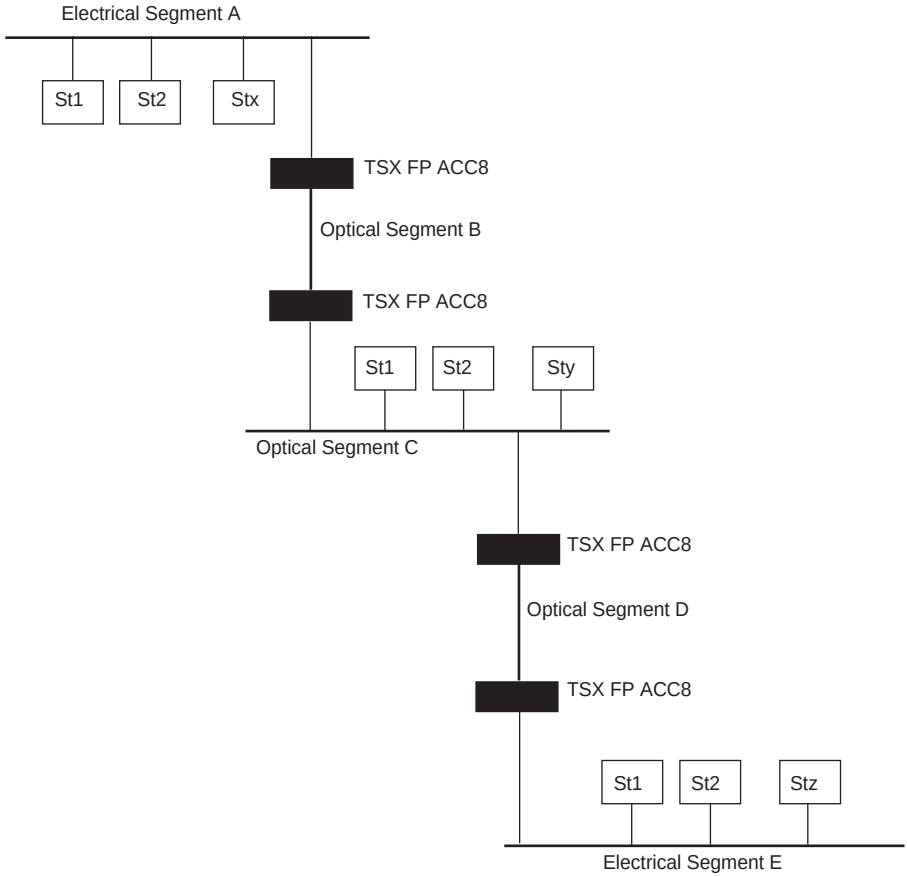
4 electrical segments A, B, E, F and 2 optical segments C, D, with 1 TSX FP ACC6 electrical repeater and 5 TSX FP ACC8 optical repeaters.



Stn FIPWAY/FIPIO electrical station

4.2-3 Example 2 : linear layout

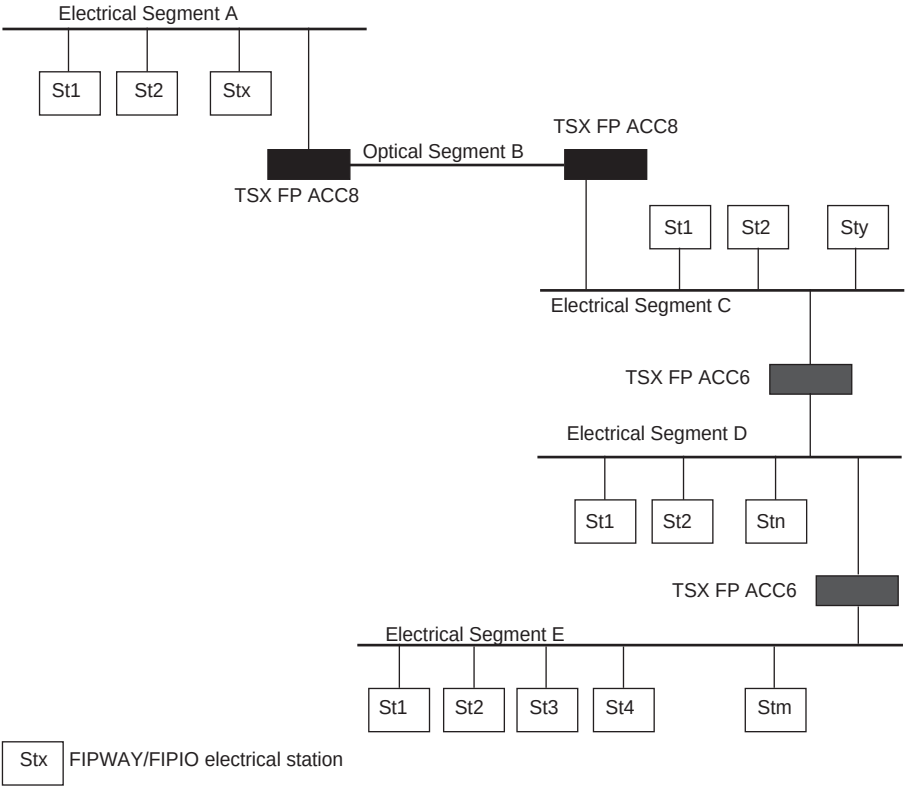
3 electrical segments A, C, E and 2 optical segments B, D, with 4 TSX FP ACC8 optical/ electrical repeaters.



Stx FIPWAY/FIPIO electrical station

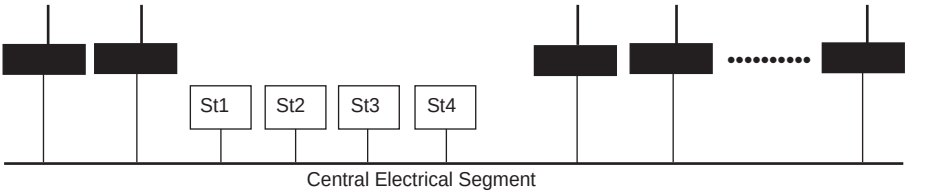
4.2-4 Example 3 : mixed layout

4 electrical segments A, C, D, E and 1 optical segment B with 2 TSX FP ACC6 electrical repeaters and 2 TSX FP ACC8 optical/electrical repeaters.



4.2-5 Example 4 : star layout

1 electrical segment with n optical/electrical repeaters.



4.3 Using the Indicators on TSX FP ACC8 Repeaters

RUN LED: this indicator lights as soon as the repeater is powered-up.

↖ or ↘ LEDs: when activity is detected on one (and only one) of the two (optical or electrical segments) connected to the repeater, it will start to send the re-generated data from the active segment to the second segment. The LED corresponding to the transmission direction (electrical to optical or optical to electrical) will then light until the segment which was initially active becomes inactive (or until an error is detected). Generally, data exchanges are performed alternately in both directions, giving the impression that the two ↖ and ↘ LEDs are always lit .
When using a link to a FIP optical station and if the activity is detected as originating from this station, the data is also sent back to the sender station.
If the two segments become active simultaneously, the repeater remains in reception mode only, until one of the two segments ceases to be active.

DEF LED: this indicator lights during normal operation to indicate an error caused by :

- The repeater itself,
- An external failure, generally a "talkative" device (one that sends a frame longer than that which is allowed by the FIP standard).

To determine the cause of the error, power-down or disconnect all other devices from the FIPWAY/FIPIO network. If the DEF LED remains lit, the repeater is faulty and must be returned for repair. Otherwise, return the various devices to service one by one, starting with the repeaters and thus locate the device which caused the error (the device found to be too "talkative").

4.4 Characteristics and Performance Levels

FIPWAY/FIPIO Network

Maximum number of repeaters per electrical segment (on condition that there are no more than 4 stations on the segment)	32
Maximum number of stations controlled logically	64
Maximum number of repeaters in cascade	4

Repeaters in cascade (optical + electrical)	Transit time for the 4 repeaters	Maximum network length (1)
4 + 0	9 µs	5 km
2 + 2	9 µs	5 km

(1) length of the electrical and optical cables between the 2 stations farthest apart.

Silicon Fiber Multimode Optical Segment

Binary data rate	1 Mb/s
Typical and maximum transit time for an optical/electrical repeater	2 µs / 2.3 µs

Characteristics of each data link according to the type of optical fiber used :

Type of fiber (2 fibers per data link)		Guaranteed dynamic range	Length allowed for 1 segment (2)	Maximum number of sections per segment
62.5/125 fiber	4 dB/km	18 dB	0 to 3 km	5
50/125 fiber	3 dB/km	12.5 dB	0 to 2.5 km	5
100/140 fiber	5 dB/km	5.5 to 21 dB	1 to 3 km	5

(2) while retaining an initial margin of 3 dB and assuming a loss of 3 dB for the connections.

TSX FP ACC8 Optical / Electrical Repeater

Electrical signals (peak-to-peak levels)			
• reception	min. 0.7 V	max. 9 V	
• transmission	min. 5.5 V	max. 9 V	distortion < 20 ns
• conductor/ground electrical isolation (50 Hz, 1 min)		1500 V rms	
Optical power levels (peak) at 850 nm, measured on a 62.5/125 µm fiber			
• reception	min. -30 dBm	max. -10 dBm	
• transmission	min. -12 dBm extinction ratio > 13 dB	max. -10 dBm	distortion < 20 ns
Power supply			
• voltage (DC)	min. 19 V	max. 60 V	
• current in normal operation	under 48 V : 80 mA		under 19 V : 210 mA
• primary/ground electrical isolation (50 Hz, 1 min)		1500 V rms	
Protection against EMI (to IEC 801.3)		level 3 (10 V/m)	
Protection against ESD (to IEC 801.2)		level 4	
RF rejection		EN55022 class A	
Protection level		IP65	
Operating temperature	min. 0 °C	max. 70 °C	
External dimensions (in mm)		L 254 x H 100 x D 78	
Approximate weight (in kg)		1.5	

Index